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NAVAL AIRCRAFT OPERATING AND SUPPORT COST MODEL - FY76 REVISION--ETC(U)
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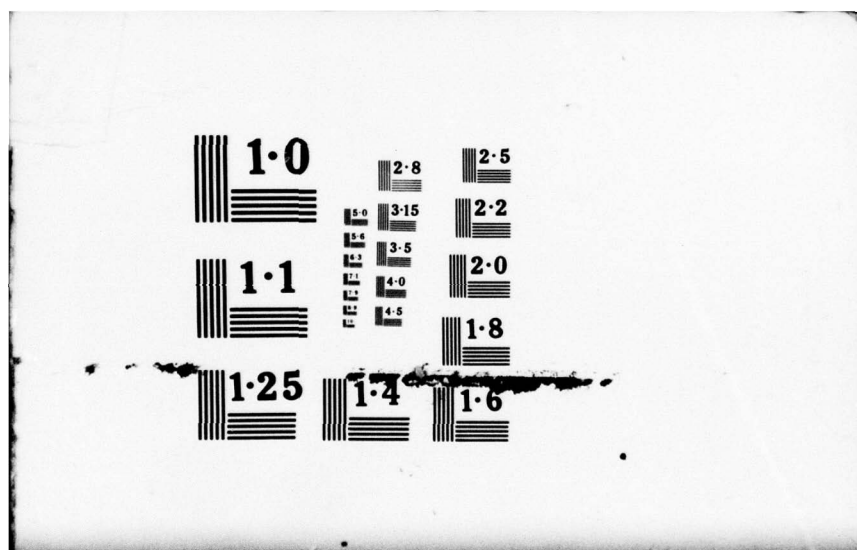
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6 NAVAL AIRCRAFT OPERATING AND SUPPORT
COST MODEL - FY76 REVISION.

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Prepared for
Office of the Chief of Naval Operations
Advisor for Resource Analysis (Op-96D)
The Pentagon
Washington, D.C. 20350

Administrative Sciences Corporation

ALEXANDRIA, VIRGINIA

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I. INTRODUCTION

In 1974 Administrative Sciences Corporation developed a parametric model for estimating Naval aircraft operating and support (O&S) costs. The model, which proved extremely useful in preparing O&S cost estimates of aircraft systems approaching a Defense Systems Acquisition Review Council (DSARC) milestone and in supporting other force/cost effectiveness studies, was first documented in ASC R-107 "A Parametric Model for Estimating Naval Aircraft Operating and Support Costs (U)," August 31, 1974. As more data became available and better data sources were identified, the model was updated and improved. The changes made were documented in ASC R-109 "Force Mix and Related Aircraft Systems Cost Analysis (U)," August 31, 1975. *NK*

Since that time the model has been continuously revised to reflect the latest available data, to utilize new data sources, to add new capabilities, and to conform to guidance from the Cost Analysis Improvement Group (CAIG). The purpose of this report, which consists of five sections with five appendices, is to document the model in its FY1976 form. Section II provides an executive summary of the report including a chart which explains, at a glance, the way the model works. Section III discusses the changes in the cost element structure (CES), Section IV details the cost-estimating relationships (CER's), and Section V contains the conclusions. The appendices and their contents are as follows:

Appendix A - Data for Cost-Estimating Relationships.

Appendix B - Computation Methodology for Technical Support (Element 18).

Appendix C - User Instructions for the Model.

Appendix D - Sample Runs.

Appendix E - Program Code.

II. EXECUTIVE SUMMARY

✓ This report documents the revisions of a parametric model for estimating Naval aircraft operating and support costs developed by Administrative Sciences Corporation. The model provides an estimate of average annual and life cycle O&S costs based on aircraft physical characteristics and basic program parameters using parametric cost-estimating relationships, cost factors and throughputs, and has been used to support numerous cost analyses prepared for CAIG review as well as other special studies such as the Naval Escort Force Mix Study and the Sea Based Air Study. It is updated often in order to remain responsive to each particular analysis, to reflect the changing nature of Naval aviation, and simply to remain timely. This report reflects the status of the model after incorporation of all FY1976 data.

The bulk of the report (~~Section IV~~) is concerned with providing a clear, concise and complete definition of each cost element and the way it is estimated by the model. ✓ If a parametric CER is used, then it is fully documented with pertinent regression statistics and the complete data base with sources noted. All cost factors are given and explained, and even the elements requiring throughput have sufficient explanatory information and examples to support a preliminary cost estimate. In short, this report is prepared so that an analyst uninitiated in the use of the model could sit down and, with a moderate amount of program information, produce an O&S estimate in a matter of hours.

Table II-1 contains a list of the cost elements estimated by the model, a very brief definition of each cost element, the estimating equation (if space permits) and a reference to the source of the data or methodology. For several

cost elements, the methodology developed for the Navy Resource Model (NARM) Program Factors Manual is used. Briefly, this is a methodology which allocates the costs of various kinds of support to weapon systems based on proxy variables which are chosen to represent the weapon systems' demand for support. Details on this can be found in Section IV. The table should give the reader a brief but accurate description of how costs are estimated by the model. Definitions for the variables used in the equations are given alphabetically for quick reference in Table II-2. More detail on each of the cost elements is contained in Section IV.

The major changes in the model since it was last documented in August, 1975, are as follows:

- 1) A complete revision of all data and equations to utilize FY76 data.
- 2) Conversion to the cost element structure and format dictated by the CAIG.
- 3) A complete recoding of the model to improve its efficiency, reduce its size, facilitate its use, and provide visibility by appropriation.

In addition to generating the average annual O&S cost per UE, the model also provides a complete life cycle cost estimate. It is generated with the average annual estimate and the average number of operating aircraft per year. The model lags the airframe and engine rework costs to put them in the year in which they would occur based on the input values for engine time-between-overhaul and airframe rework cycle. The resulting life cycle O&S estimate provides visibility by cost element and by appropriation. The sample runs in Appendix B provide examples of this capability.

TABLE II-1
AIRCRAFT OPERATING AND SUPPORT COST MODEL
COST-ESTIMATING RELATIONSHIPS

Cost Element	Definition	CER	Reference
1. Aircrew (Officers)	Officer Aircrewmembers	OA = $OxCPxOPR$	Based on program information
2. Aircrew (Enlisted)	Enlisted Aircrewmembers	EA = $ExCFxEPR$	Based on program information
3. Combat Command Staff	Non-flying Command Admin. Pers.	CCS = $(OCxOPR)+(ECxEPR)$	Based on program information and squadron size
4. Aviation POL	Fuel and additives for A/C	POLF = $9.153CTOM^{0.534}MS^{0.808}$	Based on actual usage
5. Other Deployed Manpower	Various utility and miscellaneous personnel not previously counted	ODM = $(-0.503+2.239SP^{0.500}) \times EPR$	Based on OpNAV policy
6. Air TAD	Travel and TAD expenses to obtain maintenance and other training	Thruput (usually \$5,000 - \$13,000)	Based on NARM data
7. Aircraft Maintenance Manpower	Squadron O&I level maintenance pers.	AMM = $(1.670 + 0.018MMHMO)$	Based on 3-M data
8. Maintenance Material	Non-repairable O&I level maintenance material	MM = $(0.008MS^{0.369}MMHMO^{1.098})^{0.940}$	Actual data - Op-51C
9. Personnel Support Supplies	Non-maintenance O&I level material	FSS = $(0.008MS^{0.369}MMHMO^{1.098})^{0.060}$	Actual data - Op-51C
10. Base Operating Support	Cost of base support services to squadron	BO = $0.002TSP$; BE = $0.027TSP$ BOM = $463.700 \times TSP$ BOS = $(BOMxOPR)+(BExEPR)+BOM$	NARM Methodology; Proxy number of squadron personnel
11. Component Rework	Depot repair of repairables	CR = $0.727MMH^{1.249}CTOM^{0.405}$	NAVAIR Cost factors
12. Airframe Rework	Depot repair/overhaul of airframe	AR = $-15.078 + 0.130MMHMO + 0.092MS$	Data from Naval Air Rework Facilities

TABLE II-1 (cont'd.)

<u>Cost Element</u>	<u>Definition</u>	<u>CER</u>	<u>Reference</u>
13. Engine Rework	Depot repair/overhaul of engines	EO = 1.093 + 45.064TD + 1.211 ER = 8.469 + 4.138TD + 0.752T ERT = $(\frac{EO + 1.6ER}{TBO}) \times NE$	Data from Naval Air Rework Facilities
14. Depot Supply Operations	Cost of supply depot support for A/C parts and squadron material	0.025 x (costs from #1-9, 11-13)	NARM Methodology
15. Technical Support	Large number of technical support programs	Details in Appendix B	NARM Methodology
16. Second Destination Trans.	SDT costs of A/C and squadron material	0.057(costs from 4, 8, 9, 12, 13 + AR)	NARM Methodology, Proxy all other costs
17. Individual Training	Training costs up to Readiness Squadron	TOM = 0.007(SBE) + 0.215(SBT) TO = 0.002(SBE) + 0.680(SBO) + 0.004(SBT) TE = 0.101(SBE) + 0.025(SBT) TT = TOM + (TOxOPR) + (TExEPR)	NARM Methodology, Proxy - squadron and base operating enlisted, officer and total
18. Health Care	Cost of providing health care to squadron	HOM = 0.346(SBT) HO = 0.001(SBO) + 0.010(SBT) HE = 0.005(SBE) + 0.018(SBT) HT = HOM + (HOxOPR) + (HExEPR)	NARM Methodology, Proxy - squadron and base operating officer, enlisted and total personnel
19. Personnel Activities	The cost of a number of personnel programs	Details in Section IV	NARM Methodology, Proxy - Number of personnel
20. Replenishment Spares	The cost of purchasing replenishment repairable material	RSF = $(0.727MMH)^{1.247} CTOW^{0.405}$ 0.590	NAVAIR Cost Factors
21. Modifications	The cost of safety mods for A/C and equipment	M = 0.004FC	Cost Factor used by OSD
22. Replacement of GSE	The cost of replacing GSE	RGSE = 0.003FC	Cost Factor used by OSD
23. Training Ordnance	The cost of all expendables used in training	Determined by weapons on A/C and training requirements	Refer to Table IV-1 for guidelines

TABLE 11-2
ALPHABETICAL LISTING OF VARIABLES

Variable	Definition	Cost Element Reference	Variable	Definition	Cost Element Reference
AMM	the cost of aircraft maintenance manpower	7	MS	the maximum speed for level flight at altitude given in miles per hour	4,8,9,12
AR	the unit cost of an airframe rework (in thous.)	12	NE	the number of engines per aircraft	13
BE	the number of base operating enlisted necessary to support the squadron	10	O	the number of officers per aircrew	1
BO	the number of base operating officers necessary to support the squadron	10	OA	the cost of paying the officer aircrewmembers	1
BOM	the O&M funds necessary to support the squadron	10	OC	the number of combat command staff officers divided by the number of squadron aircraft	3
BOS	the total cost of base operating support	10	ODM	the number of other deployed manpower per aircraft	5
CCS	the cost of combat command staff manpower	3	OPR	the officer pay rate	13,10
CF	the crew factor or the number of aircrews contained in the squadron divided by the number of aircraft	1,2	POLF	the cost per flying hour of POL assuming a base price of \$0.394 per gallon of JP-5	4
CRF	the component rework cost per flying hour	11,20	PSS	the cost per flying hour of personnel support supplies	9
D	engine diameter in inches	13	RCSE	the cost of replacement GSE	22
E	the number of enlisted personnel per aircrew	2	RSP	the cost of replenishment spares per flying hour	20
EA	the cost of paying enlisted aircrewmembers	2	SBE	the number of squadron enlisted personnel (from Elements 2,3,4, and 7) and base operating enlisted (from Element 10)	17,18
EC	the number of combat command staff enlisted divided by the number of squadron aircraft	3	SBO	the number of squadron officers and base operating officers	17,18
EO	the unit cost of an engine overhaul (in thous.)	13	SBT	the number of squadron enlisted personnel and officers (from Elements 2 & 3) and base operating enlisted and officers	17,18
EPR	the enlisted pay rate	2,3,5,10,17,18	SP	the total number of personnel in the squadron to be supported	5
ER	the unit cost of an engine repair (in thous.)	13	T	maximum engine thrust	13
ERT	the total annual engine rework cost per aircraft	13	TBO	time between overhaul given in engine operating hours	13
FC	the flyaway cost per aircraft (in thous.)	21,22	TE	the number of enlisted personnel required for training duties	17
GTOW	the gross take-off weight (in thous. of lbs.)	4,11,20	TD	turbofan dummy variable	13
HE	the number of health care enlisted personnel	18	TO	the number of officer staff required for training duties	17
HO	the number of health care officers	18	TOM	training O&M funds	17
HOM	health care O&M funds	18	TSP	total number of squadron personnel	10
HT	the total cost of health care	18	TT	total training cost	17
M	the cost of aircraft safety modifications	21			
MM	the annual cost per flying hour of maintenance material	8			
MMH	the number of maintenance manhours per flying hour necessary to support an aircraft	11,20			
MMHMO	the number of maintenance manhours per month required to support an aircraft	7,8,9,12			

III. COST ELEMENT STRUCTURE

The revised model incorporated several changes in the cost element structure (CES) which were instituted to conform with guidance from the Cost Analysis Improvement Group (CAIG). Because previous editions of this model have been based on CAIG guidance, the changes were minor - primarily a matter of reformatting. Table III-1 provides a comparison of the old CES (Column A) and the revised CES (Column B). The latter is the CAIG preferred format with minor changes to reflect the unique mission and organization of the Navy.

The personnel which are costed are those of the deployable squadron. Although the members of the squadron do not discretely fall into the functional categories outlined in the CES, as they do in other services, they nevertheless can be divided according to their primary function. Therefore elements 1 (Aircrew, Officers), 2 (Aircrew, Enlisted), 3 (Combat Command Staff), 5 (Other Deployed Manpower) and 7 (Aircraft Maintenance Manpower), when summed, equate to the deployable squadron.

Several elements, although unchanged, were split into one or more new elements and vice-versa. The old element of Squadron Maintenance Material and Other Consumables (CE. 5, Column A) was broken into two elements - Maintenance Material (CE. 8, Column B) and Personnel Support Supplies (CE. 9, Column B). This was done to provide visibility into these two distinct areas of cost. Also Logistics Support (CE. 21, Column A) was divided into Depot Supply Operations (CE. 14, Column B), Technical Support (CE. 15, Column B) and Second Destination Transportation (CE. 16, Column B). Conversely, Recruiting and

Examining (CE. 17, Column A), Transients (CE. 18, Column A), Prisoners (CE. 19, Column A) and Permanent Change of Station (CE. 20, Column A) were combined into a single element Personnel Activities (CE. 19, Column B). All other elements remain the same even though some have slightly different titles and are shown under different headings. Each element in Column B will be discussed in detail in Section IV.

TABLE III-1
COMPARISON OF COST CATEGORIES

August 31, 1975 Cost Categories	Revised Cost Categories
<u>Column A</u>	<u>Column B</u>
<u>Squadron Operations</u>	<u>Deployed Unit Operations</u>
1. Crew Manpower	1. Aircrew (Officers)
2. Maintenance and Support Manpower	2. Aircrew (Enlisted)
3. Squadron Administration	3. Combat Command Staff
4. Aviation POL	4. Aviation POL
5. Squadron Maintenance Material and Other Consumables	5. Other Deployed Manpower
6. Air TAD	6. Air TAD
<u>Depot Support</u>	<u>Below Depot Maintenance</u>
7. Component Rework	7. Aircraft Maintenance Manpower
8. Engine Rework	8. Maintenance Material
9. Airframe Rework	9. Personnel Support Supplies
<u>Recurring Investment</u>	<u>Installation Support</u>
10. Replenishment Spares	10. Base Operating Support
11. Aircraft Modifications	<u>Depot Maintenance</u>
12. Replacement of Ground Support Equipment	11. Component Rework
13. Training Ordnance	12. Airframe Rework
<u>General Support</u>	13. Engine Rework
14. Base Operating Support	<u>Depot Supply</u>
14. Training Support	14. Depot Supply Operations
16. Medical Support	15. Technical Support
17. Recruiting & Examining	<u>Second Destination Transportation</u>
18. Transients	16. Second Destination Transportation
19. Prisoners	<u>Personnel Support and Training</u>
20. Permanent Change of Station	17. Individual Training
21. Logistics Support	18. Health Care
	19. Personnel Activities
	<u>Sustaining Investments</u>
	20. Replenishment Spares
	21. Modifications
	22. Replacement of Ground Support Equipment
	23. Training Ordnance

IV. COST-ESTIMATING RELATIONSHIPS

This section provides a definition of each cost element and a description of the cost-estimating relationship (CER) used in the model to provide an estimate. Each CER is based on what is judged to be the best available historical data, but as one might expect, the quality of the data and therefore the precision of the CER's vary considerably. Several of the cost elements are estimated with the methodology used by the Navy Resource Model (NARM) Program Factors Manual which allocates support costs to weapon systems on the basis of proxy variables. This methodology, which is discussed in more detail in the discussion of Base Operating Support (CE. 10), is useful because it provides a way to estimate the cost of support services which would otherwise be extremely difficult to identify to a specific weapon system. Finally, there are several cost elements which are not dependent on the characteristics of the aircraft and therefore are virtually impossible to treat parametrically in a generalized model. Training Ordnance is an example. In such cases, as much background data as possible is provided to allow the analyst to make an initial, reasonable estimate until program information is obtained, such as in the case of Training Ordnance, a list of weaponry and training allowances.

It should be noted that each cost or manpower reference is given on a per aircraft basis unless otherwise specified. Costs are in FY76 dollars.

1. Aircrew (Officers)

This is the cost of paying officer personnel who operate the squadron

aircraft. Although all pilots perform other duties in the squadron, such as maintenance supervision or squadron staff functions, their primary duty is considered to be that of aircrew and their full cost is shown in this element.

$$OA = O \times CF \times OPR$$

where,

OA = the cost of paying the officer aircrewmembers

O = the number of officers per aircrew

CF = the crew factor or the number of aircrews contained in the squadron divided by the number of aircraft

OPR = the officer pay rate* (FY76 = \$20,272)

2. Aircrew (Enlisted)

This is the cost of paying enlisted personnel who perform as crewmembers for the aircraft. Although they may perform maintenance or other duties when not flying, their cost is shown in this element.

$$EA = E \times CF \times EPR$$

where,

EA = the cost of paying enlisted aircrewmembers

E = the number of enlisted personnel per aircrew

CF = the crew factor

EPR = the enlisted pay rate* (FY76 = \$8,810)

*Pay is defined here and throughout this report as the average annual pay rate by categories (officer, enlisted, cadet and trainee) found in the Five Year Defense Program (FYDP) for military pay and allowances. The rates are obtained by dividing total military pay and allowances for each category by the average annual military strength in each category and are readily available through the Navy Resource Model (NARM) Program Factors Manual prepared by Op-901. Should it be determined that rates other than the Navy average are preferable, they may be easily input into the model as described in Appendix C.

3. Combat Command Staff

This element represents the pay of manpower necessary for management and supervision of squadron operations. It typically includes the personnel found in the Squadron Administration Department provided they are not already costed in Element 1. Aircrew (Officers) or 2. Aircrew (Enlisted).

$$CCS = (OC \times OPR) + (EC \times EPR)$$

where,

CCS = the cost of combat command staff manpower

OC = the number of combat command staff officers
divided by the number of squadron aircraft

OPR = the officers pay rate

EC = the number of combat command staff enlisted
divided by the number of squadron aircraft

EPR = the enlisted pay rate

4. Aviation POL

Aviation POL is the cost of petroleum, oil and lubricants (including fuel additives) consumed by aircraft in flight operations and maintenance.

It is estimated with the following equation:*

$$POLF = 0.153 \times GTOW^{0.534}_{(4.38)} \times MS^{0.808}_{(8.13)}$$

$$\bar{R}^2 = 0.916$$

$$N = 10$$

$$F = 50.0$$

$$S.E.E. = 1.88$$

* t statistics are given in parentheses below the estimated value.

where,

POLF = the cost per flying hour of POL assuming
a base price of \$0.394 per gallon of JP-5

GTOW = the gross take-off weight of the aircraft in
thousands of pounds

MS = the maximum speed for level flight at altitude
given in miles per hour

5. Other Deployed Manpower

This is the cost of all squadron personnel who are not costed in Elements 1. Aircrew (Officers), 2. Aircrew (Enlisted), 3. Combat Command Staff, or the Maintenance Department covered by Element 7. Aircraft Maintenance Manpower. It consists primarily of the Integrated Services section of the squadron and contains commissarymen, food servicemen, laundrymen, stewards, supply clerks, pay clerks, medical technicians and other miscellaneous billets. It is calculated with the following equation:

$$\text{ODM} = -0.503 + 0.230 \times (\text{SP})^{0.5} \\ (26.04)$$

$$\bar{R}^2 = 0.983$$

$$N = 13$$

$$F = 678$$

$$\text{S.E.E.} = 2.83$$

where,

ODM = the number of other deployed manpower per aircraft

SP = the total number of personnel in the squadron to
be supported.

SP can be computed with the following equation:

$$\text{SP} = ((O+E) \times \text{CF} + \text{OC} + \text{EC} + \text{MO}) \times \text{NA}$$

where,

- O = the number of officers per aircrew (from Element 1)
- E = the number of enlisted per aircrew (from Element 2)
- CF = the crew factor (from Element 1)
- OC = the number of combat command staff officers per aircraft (from Element 3)
- EC = the number of combat command staff enlisted per aircraft (from Element 3)
- MO = the number of maintenance and operating personnel per aircraft (from Element 7)
- NA = the number of aircraft per squadron

6. Air Temporary Additional Duty (TAD)

This is the cost of travel, lodging and incidental expenses incurred so that squadron personnel can receive training, usually maintenance-related. Because of its small size and insensitivity to aircraft characteristics, it is estimated outside the model and throughput. Annual TAD costs range from \$2,000 to \$24,000 per aircraft, but usually are in the \$5,000 - \$13,000 range. They can be estimated by examining the NARM data for a similar aircraft.

7. Aircraft Maintenance Manpower

This element consists of the cost of all manpower necessary to support the total preventive and corrective maintenance actions performed on the aircraft and its installed systems and equipments. This includes the squadron personnel who are assigned TAD to the Aircraft Intermediate Maintenance Department. It is estimated with the following CER:

$$\text{AMM} = (1.670 + 0.018\text{MMHMO}) \times \text{EPR} \\ (11.81)$$

$$\bar{R}^2 = 0.933$$

$$N = 11$$

$$F = 139$$

$$S.E.E. = 2.23$$

where,

AMM = the cost of aircraft maintenance manpower

MMHMO = the number of direct maintenance manhours per month required to support a single aircraft

EPR = the enlisted pay rate

8. Maintenance Material

This is the cost of all maintenance supplies whether acquired by the Navy Stock Fund (NSF) or any other method of funded purchase which are not repaired for reuse. The costs are incurred at both the organizational and intermediate level.

The costs of Maintenance Material and Personnel Support Supplies (Element 9) are estimated with a single equation and allocated according to the relative average costs observed in the fleet. The equation for the cost per flying hour is:

$$MM = (0.008MS \frac{0.369}{(2.60)} \times MMHMO \frac{1.098}{(5.14)}) \times 0.96$$

$$\bar{R}^2 = 0.809$$

$$N = 10$$

$$F = 24.0$$

$$S.E.E. = 0.26$$

where,

MM = the annual cost per flying hour of maintenance material

MS = the maximum speed for level flight at altitude given in miles per hour

MMHMO = the number of direct maintenance manhours per month required to support a single aircraft

9. Personnel Support Supplies

This cost element is often grouped with Element 8 in Navy data systems but is not maintenance related. The Personnel Support Supplies element is comprised of non-maintenance, aircrew-oriented supplies used by the squadron which relate to the health, safety and welfare of the crew, such as, flight suits, oxygen masks, charts, maps, in-flight meals, and others. The equation is:

$$PSS = (0.008MS^{0.369}_{(2.60)} \times MMHMO^{1.098}_{(5.14)}) \times 0.04$$

$$\bar{R}^2 = 0.809$$

$$N = 10$$

$$F = 24.0$$

$$S.E.E. = 0.26$$

where,

PSS = the cost per flying hour of personnel support supplies

MS = the maximum speed for level flight at altitude given in miles per hour

MMHMO = the number of direct maintenance manhours per month required to support a single aircraft

10. Base Operating Support

This is the cost of base manpower and operating funds necessary to provide the base services which support the squadron. Included in this cate-

gory are those personnel who are assigned to the base (not the squadron) and work in the laundry, mess, supply room and other areas. It also includes the base personnel who are permanently assigned to the AIMD of the air station. Since it is often difficult to determine the variable impacts on base operating support costs of the addition or deletion of a force unit such as an aircraft, the methodology used in the Navy Resource Model (NARM) Program Factors Manual was adopted to provide an estimate for Base Operating Support costs as well as several other elements which are similar in nature. Simply speaking, the NARM methodology identifies total support costs of specific type, such as B.O.S. costs, and allocates those costs back to the force units based on some proxy variable which is chosen to approximate that force unit's demand for support. Usually the proxy is direct manpower although not always. In each case where the NARM methodology is used in the succeeding elements, it will be identified and the methodology, factors and proxies will be identified.

For B.O.S. the computation is done in the following manner. The costs contained in program elements 24611N, 24612N, 24613N, 24614N, 24615N, 24617N, 24618N and 72827N are summed and divided by three, because only one-third of the total B.O.S. costs are considered variable with the forces. The one-third of the fund which is to be allocated is done so based on the number of squadron personnel (including Integrated Services) associated with the aircraft, i.e., the more personnel required to operate and support the aircraft, the more base services are required. The computation is as follows:

$$BO = 0.007 \times TSP$$

$$BE = 0.027 \times TSP$$

$$BOM = 463.712 \times TSP$$

$$BOS = (BO \times OPR) + (BE \times EPR) + BOM$$

where,

- BO = the number of base operating officers necessary to support the squadron
- TSP = total number of squadron personnel
- BE = the number of base operating enlisted necessary to support the squadron
- BOM = the O&M funds necessary to support the squadron
- BOS = the total cost of base operating support
- OPR = the officers pay rate
- EPR = the enlisted pay rate

11. Component Rework

This is the cost of reworking or repairing components of the aircraft and its associated support equipment. This maintenance, which generally involves greater technical capability and more extensive facilities than are available at base level, is usually performed at the Naval Air Rework Facilities but can also be done by another service or by a contractor. When the work is done by another service or a contractor the cost is usually shown as a fixed price amount. When it is done by the NARF it consists of labor, material and overhead. The equation is:

$$CRF = 0.727 \text{MMH}^{\frac{1.249}{(3.15)}} \times \text{GTOW}^{\frac{0.405}{(1.43)}}$$

$$\bar{R}^2 = 0.560$$

$$N = 11$$

$$F = 6.0$$

$$\text{S.E.E.} = 0.42$$

where,

CRF = the component rework cost per flying hour

MMH = the number of maintenance manhours per flying hour necessary to support an aircraft

GTOW = the gross take-off weight (in thousands of pounds)

12. Airframe Rework

This is the cost including labor, material and overhead of making periodic inspections, repairs and overhaul of the airframe to assure its material condition. Since the periodic rework of an airframe does not occur every year, the model annualizes the unit cost by dividing by the rework cycle (the sum of the rework interval plus duration in months) and multiplying by 12 months. The CER given below provides an estimate of the unit cost.

$$AR = -15.078 + \frac{0.130}{(3.11)}MMHMO + \frac{0.092}{(2.51)}MS$$

$$\bar{R}^2 = 0.753$$

$$N = 12$$

$$F = 17.8$$

$$S.E.E. = 53.76$$

where,

AR = the unit cost of an airframe rework (in thousands)

MMHMO = the number of direct maintenance manhours per month required to support a single aircraft

MS = the maximum speed for level flight at altitude given in miles per hour

13. Engine Rework

This is the cost of repairing and overhauling aircraft engines primarily at the Naval Air Rework Facilities. Repair costs are incurred as needed and can be estimated based on historical data of aircraft with similar

engines, performance characteristics, missions, and flight profiles. Overhaul costs are incurred periodically according to maintenance policy and depend on the complexity, size, configuration, etc. of the engine. Both repair cost and overhaul cost can be expressed on a per flying hour basis. The frequency of engine repairs versus engine overhauls is assumed to be the same as the relative number of occurrences of repairs versus overhauls (1.6 for FY76) in the NARF data for the engines in the sample. The equations for estimating these costs are as follows:

$$EO = 1.093 + 45.064TD + 1.211D$$

(7.29) (3.63)

$$\bar{R}^2 = 0.949$$

$$N = 9$$

$$F = 76.1$$

$$S.E.E. = 7.10$$

where,

EO = the unit cost of an engine overhaul (in thousands)

TD = turbofan dummy variable

TD = 1 for turbofan engines

TD = 0 otherwise

D = engine diameter in inches

$$ER = 8.469 + 4.138TD + 0.752D$$

(2.76) (5.22)

$$\bar{R}^2 = 0.878$$

$$N = 9$$

$$F = 29.8$$

$$S.E.E. = 1.90$$

where,

ER = the unit cost of an engine repair (in thousands)

TD = turbofan dummy variable

TD = 1 for turbofan engines

TD = 0 otherwise

T = maximum engine thrust

$$ERT = \frac{EO + 1.6ER}{TBO} \times NE$$

where,

ERT = the total annual engine rework cost per aircraft

EO = engine overhaul cost (previously defined)

ER = engine repair cost (previously defined)

TBO = time between overhaul given in engine operating hours

NE = the number of engines per aircraft

14. Depot Supply Operations

This element represents the cost of managing the inventory of maintenance spare parts needed to support aircraft systems. When a new aircraft is introduced into the force, spare parts are procured to sustain aircraft operations. These parts are introduced into the supply system and resources are expended to manage (store, distribute, package and crate) these spares inventories. Based on past experience, factors are developed which size the cost of additional inventory management.

The NARM computed this cost by taking the cost shown in program element 71111N - Supply Depot Operations, and allocating to all ships and aircraft on the basis of direct requirements of manpower and operating funds i.e., MPN, O&M and APN. Specifically the equation is:

$$\text{SDO} = 0.025 \times (\text{total cost of elements 1-9} + 11-13)$$

15. Technical Support

This is the cost of a number of programs, usually managed centrally, which support aircraft operations. A partial list of these programs is given below:

- Contractor Engineering Technical Services (CETS)
- Navy Engineering Technical Services (NETS)
- Depot Rework of Ground Support Equipment (GSE)
- Installation and Calibration of GSE
- Depot rework of Catapult and Arresting Gear
- Technical Publications Updates
- NAVAIRSYSCOM Representatives

The methodology for this element is quite complicated because of the large number of activities, costs, and proxy variables involved and will not be dealt with in detail here. Appendix B contains the complete, step-by-step methodology used to compute Technical Support.

16. Second Destination Transportation

This element represents the cost of shipping material needed to support the aircraft unit. Material includes: (1) spare and repair parts that are shipped between the centralized repair depots and the aircraft unit; and (2) support items that are needed by aircraft unit personnel such as food and office supplies. The NARM estimates Second Destination Transportation by allocating the costs contained in program element 78010N - Second Destination Transportation on the basis of direct requirements of operating funds. Specifically,

the equation is:

$$\text{SDT} = (0.057) \times (\text{cost of elements 4,8,9,12,13 and the unit cost of an airframe rework})$$

17. Individual Training

This is the cost of paying personnel in training who will replace unit personnel, the training staff and training operating funds. This includes all training from recruit training through undergraduate pilot and navigator training, as well as the operation and maintenance of trainers and simulators by the Fleet Aviation Specialized Operational Training Detachments (FASOTRA-DET's) and the Naval Air Maintenance Training Detachments (NAMTRADET's). This element does not include any aspect of Readiness Training which is costed as a separate squadron.

The NARM computes this cost by summing all of the costs of the students and two-thirds the cost of staff personnel and operating funds for the program elements shown below and allocates to the aircraft on the basis of personnel.

81114N Flight Training
 81111N Recruit Training
 81112N Specialized Training
 81113N Professional Training
 24633N Fleet Support Training
 88097N Administrative Support Training

The equations are:

$$\begin{aligned} \text{TOM} &= 0.007(\text{SBE}) + 0.215(\text{SBT}) \\ \text{TO} &= 0.068(\text{SBO}) + 0.004(\text{SBT}) \\ \text{TE} &= 0.101(\text{SBE}) + 0.025(\text{SBT}) \\ \text{TT} &= \text{TOM} + (\text{TO} \times \text{OPR}) + (\text{TE} \times \text{ERR}) \end{aligned}$$

where,

TOM = training O&M funds

SBE = the number of squadron enlisted personnel
(from Elements 2,3,4, and 7) and base operating
enlisted (from Element 10)

SBT = the number of squadron enlisted personnel and
officers (from Elements 2 and 3) and base oper-
ating enlisted and officers

TO = the number of officer staff required for training
duties

SBO = the number of squadron officers and base operating
officers

TE = the number of enlisted personnel required for
training duties

TT = total training cost

OPR = officer pay rate

EPR = enlisted pay rate

18. Health Care

This is the cost of medical personnel and materials needed to provide medical support to aircraft unit personnel and to base personnel who provide direct support to the aircraft. The NARM estimates this cost by summing the variable portion (2/3) of the cost of medical operations and adding the pay of patients. The program elements used are given below:

81211N Hospitals

81212N Medical Centers

81216N Other Medical Activities

81213N Patients

The procedure used to estimate this cost using NARM methodology is as follows:

$$\begin{aligned} \text{HOM} &= 0.346(\text{SBT}) \\ \text{HO} &= 0.001(\text{SBO}) + 0.010(\text{SBT}) \\ \text{HE} &= 0.005(\text{SBE}) + 0.081(\text{SBT}) \\ \text{HT} &= \text{HOM} + (\text{HO} \times \text{OPR}) + (\text{HE} \times \text{EPR}) \end{aligned}$$

where,

$$\begin{aligned} \text{HOM} &= \text{health care O\&M funds} \\ \text{SBT} &= \text{the number of squadron enlisted personnel and officers (from Elements 2 and 3) and base operating enlisted and officers} \\ \text{HO} &= \text{the number of health care officers} \\ \text{SBO} &= \text{the number of squadron officers and base operating officers} \\ \text{HE} &= \text{the number of health care enlisted personnel} \\ \text{SBE} &= \text{the number of squadron enlisted personnel (from Elements 2,3,4, and 7) and base operating enlisted (from Element 10)} \\ \text{HT} &= \text{the total cost of health care} \\ \text{OPR} &= \text{officer pay rate} \\ \text{EPR} &= \text{enlisted pay rate} \end{aligned}$$

19. Personnel Activities

This is the cost of permanent change of station (PCS), recruiting and examining activities, transients and prisoners. PCS is the cost of duty station rotation for all squadron and supporting personnel. PCS rates are figured for officers and enlisted personnel by dividing the total PCS cost by the number of personnel, producing a PCS cost per person. This is multiplied by the number of personnel as shown in the following equation:

$$\text{PCS} = 1760(\text{SBO}) + 542(\text{SBE})$$

where,

PCS = the annual cost of PCS for squadron personnel

SBO = the number of squadron officers and base operating officers

SBE = the number of squadron enlisted personnel
(from Elements 2,3,4, and 7) and base operating
enlisted (from Element 10)

The remainder of the cost for this element is computed by the NARM by summing two-thirds of the cost of recruiting and examining and all the cost of transients and prisoners. The program elements and computational procedures are given below:

81412N Recruiting & Examining

81411N Prisoners

81415N Transients

REOM = 0.102(SBE)

REO = 0.001(SBE)

REE = 0.008(SBE)

PE = 0.003(SBE)

TO = 0.058(SBO)

TE = 0.051(SBE)

TPA = PCS+REOM+(REOxOPR)+(REExEPR)+(PExEPR)+(TOxOPR)+(TExEPR)

where,

REOM = recruiting and examining O&M funds

SBE = the number of squadron enlisted personnel
(from Elements 2,3,4, and 7) and base operating
enlisted (from Element 10)

REO = recruiting and examining officers
REE = recruiting and examining enlisted
PE = enlisted prisoners
TO = the number of officer transients
SBO = the number of squadron officers and base operating officers
TE = the number of enlisted transients
TPA = the total cost of personnel activities
OPR = officer pay rate
EPR = enlisted pay rate

20. Replenishment Spares

This is the cost of procuring aircraft assemblies, spares and repair parts which are normally repaired and returned to stock. In addition, it includes procurement of stock levels that are not provided by initial spares procurement. These are centrally managed investment type items. This cost is estimated as a percentage of Component Rework cost. The same procedure is utilized by NAVAIR in preparation of their program factors and also by the NARM Program Factors Manual, although the NARM adjusts the relationship to reflect the overall relationship of Component Rework and Replenishment Spares funding. The model follows the NARM methodology and estimates with the relationship given below:

$$RSF = 0.59 \text{ CRF}$$

where,

RSF = the cost of replenishment spares per flying hour
CRF = the cost of component rework per flying hour

21. Modifications

The cost of modifying aircraft, ground equipment, and training operations to enable them to perform mission essential tasks (not new capability), and to improve reliability or reduce maintenance cost. This includes the cost of purchasing the modifications including the requisite engineering plus the cost of depot installation. There is no installation cost involved at the organizational and intermediate levels since those personnel are dedicated to support of the aircraft and their time is included in the other cost elements. This cost is estimated as a percentage of flyaway cost. The equation is:

$$M = 0.004FC$$

where,

M = the cost of aircraft safety modifications

FC = the flyaway cost per aircraft (in thousands)

22. Replacement of Ground Support Equipment

This is the cost of replacement of ground servicing equipment, maintenance and repair shop equipment, instruments and laboratory test equipment, and other miscellaneous items such as ground generators, jet engine test stands, test sets for radios, radars, and fire control systems, hand tools, compressors, and gauges. These equipment demands are generated by the need to replace common and peculiar ground support equipment that is worn out or destroyed. This cost element is also estimated as a percentage of flyaway cost. The equation is:

$$RGSE = 0.003FC$$

where,

RGSE = the cost of replacement GSE

FC = the flyaway cost per aircraft (in thousands)

23. Training Ordnance

This is the cost of all conventional expendables used in non-combat flight operations of squadron aircraft for the purpose of keeping aircrews proficient in weapons delivery techniques. It includes the cost of sonobuoys, pyrotechnics, ballistic and guided weapons, as well as all conventional ordnance. Because the cost of Training Ordnance is not related to the physical characteristics or reliability and maintainability parameters which have been used throughout the model, an estimate must be made outside the model. To do this the analyst must first determine the weaponry installed or carried on the aircraft and then find the number that must be expended annually to maintain readiness.

For the purpose of providing a guideline the following table (IV-1) provides a listing of planned ordnance expenditures for several types of aircraft. It is important to note that actual expenditures can vary significantly depending on funding considerations, war reserve stockpile considerations, and other reasons. The table also does not contain any air-launched missile costs, which should be included in an O&S analysis if there are operational launches. It is assumed, however, that the use of the Advanced Combat Maneuvering Ranges (ACMR's) will eliminate most of missile firings done simply for training purposes.

TABLE IV-1
 REPRESENTATIVE ANNUAL TRAINING ORDNANCE COSTS

<u>Weapon</u>	<u>Unit Cost</u>	<u>- Annual Cost per A/C -</u>		
		<u>Attack</u>	<u>Fighter</u>	<u>ASW</u>
MK-87WSF	83	1,494	9,960	996
MK-76	11	5,040	268	1,702
MK-77	440	—	—	—
MK-106	14	861	—	—
MK-82	570	13,680	9,120	—
MK-83	1,150	2,300	—	—
MK-84	1,900	1,900	—	—
30mm	6	—	—	—
MK-12 20mm	2	6,000	—	—
M61 20mm	2	11,750	5,640	—
MK-24/25FLARE	135	4,050	1,620	5,400
ZUNI	571	9,136	9,136	9,136
FF 2.75(U)	60	4,200	4,200	4,200
AN/SSQ 41	160	—	—	12,800
AN/SSQ 53	465	—	—	13,950
AN/SSQ 50	450	—	—	18,000
AN/SSQ 62	645	—	—	19,350
AN/SSQ 47	450	—	—	18,000
AN/SSQ 36	145	—	—	1,450
MK-46	3,021	—	—	6,042
TOTAL		60,411	39,944	111,026

V. CONCLUSIONS

The aircraft operating and support cost model, described in detail in the preceding sections, has been used to support many analytical studies and has proven to be accurate and useful. Despite this practical endorsement it is important to continually assess the model's capabilities, to identify the weaker aspects, and to look for ways of improving them. The following areas were judged to be ones that would benefit from further study.

Fiscal 1977 Data - The data for fiscal 1977, which should be available shortly, should be obtained and used to update the equations. This is necessary to reflect the changes in the aircraft inventory, maintenance policies, prices, operational scenarios, and many other parameters.

New Data Sources - With the preparation of FY77 data, new sources become available which should enhance the capability for estimating Component Rework and Replenishment Spares costs. The primary new data source is the Visibility and Management of Operating and Support Costs (VAMOSC) System and although it began publishing data for FY75, program errors have caused notable problems so far. The FY77 VAMOSC data for Component Rework, although still algorithmic rather than historical, should provide a much improved data base for developing CER's for Component Rework and Replenishment Spares.

Modifications and Replacement of Ground Support Equipment - These two elements, which are currently being estimated as a percentage of flyaway cost, should be examined in further detail. A recent application of this model

to future aircraft highlighted the fact that maintenance costs are declining as aircraft are being designed to be more maintainable and reliable, but Modifications and Replacement GSE are becoming more costly as the costs of new hardware increase. Data should be obtained so that a CER can be developed or, at least, so the current factors can be updated or verified. In other words, these two elements promise to become increasingly prominent in the future O&S analyses, therefore it is important that the estimating precision increase accordingly. Data should be obtained to permit CER development or, at least, to permit verification or revision of the factors currently being used.

APPENDIX A

DATA FOR COST-ESTIMATING RELATIONSHIPS

(U) TABLE A-1

DATA BASE FOR PETROLEUM, OIL AND LUBRICANTS (POL)
COST-ESTIMATING RELATIONSHIP (U)

<u>Aircraft</u>	1 <u>POL Cost Per Flying Hr.</u>	2 <u>Gross Take-off Weight (Thous.lbs.)</u>	3 <u>Max Speed (mph)</u>
A-4F	193.1	27.4	675
A-6E	372.3	58.6	648
A-7E	238.3	42.0	698
E-1B	64.1	24.0	243
E-2B	150.3	51.7	368
F-4J	545.1	54.6	1,717
F-8H	283.2	30.0	1,400
P-3C	271.8	135.0	471
RA-5C	527.7	80.0	1,500
S-3A	147.3	42.5	498

Sources:

¹ Op-51C, Flying Hour Cost Report, OPNAVINST 7310.1B.

² Jane's All the World's Aircraft, 1974-75.

³ Ibid.

(U) TABLE A-2

DATA BASE FOR OTHER DEPLOYED MANPOWER COST-ESTIMATING RELATIONSHIPS (U)

¹ Other Deployed <u>Manpower (Sqn.Total)</u>	² Number of Squadron <u>Personnel to be Supported</u>
0	0
4	25
10	50
14	75
18	100
27	150
33	200
38	250
43	300
49	400
54	500
59	600
64	700

Sources:

¹ OPNAVINST C5311.3G (CONFIDENTIAL)

² Ibid.

(U) TABLE A-3

DATA BASE FOR OPERATING CONSUMABLES
COST-ESTIMATING RELATIONSHIP (U)

<u>Aircraft</u>	<u>1</u> Oper. Con. Cost per Flying Hour	<u>2</u> Direct Maint. MH per month	<u>3</u> Max Speed (mph)
A-4F	80.2	462	675
A-6E	153.3	1,119	648
A-7E	126.4	734	698
E-1B	83.9	512	243
E-2B	177.6	1,339	368
F-4J	282.6	981	1,717
F-8H	165.8	780	1,400
P-3C	142.8	994	471
RA-5C	716.0	1,911	1,500
S-3A	221.6	976	498

Sources:

- ¹ Op-51C, Flying Hour Cost Report, OPNAVINST 7310.1B
- ² 3-M Aircraft Maintenance Cost Report, MS04790.A2391-01 for FY1976
- ³ Jane's All the World's Aircraft, 1974-75

(U) TABLE A-4

DATA BASE FOR COMPONENT REWORK COST-ESTIMATING RELATIONSHIP (U)

<u>Aircraft</u>	<u>1</u> <u>Component Rework</u> <u>Cost per Flying Hour</u>	<u>2</u> <u>Maint. MH</u> <u>per Flying Hour</u>	<u>3</u> <u>Gross Take-off</u> <u>Weight (Thous. lbs.)</u>
A-4F	137	21.1	27.4
A-6E	543	37.8	58.6
EA-6B	543	44.3	58.6
A-7A	203	31.2	42.0
A-7E	339	25.5	42.0
E-1B	123	36.1	24.0
E-2B	445	43.7	51.7
F-4J	270	43.4	54.6
F-14A	607	54.9	72.0
P-3B	143	19.1	135.0
S-3A	272	30.1	42.5

Sources:

- 1 "Navy Program Factors", FY1976 Naval Air Systems Command, January 1976
- 2 3-M Aircraft Maintenance Cost Report, MS04790.A2391-01 for FY1976
- 3 Jane's All the World's Aircraft, 1974-75

(U) TABLE A-5

DATA BASE FOR AIRFRAME REWORK COST-ESTIMATING RELATIONSHIP (U)
 (Costs in Thous. of FY76\$)

<u>Aircraft</u>	<u>1</u> <u>A/C Rework</u> <u>Unit Cost</u>	<u>2</u> <u>Direct Maintenance</u> <u>MH per Month</u>	<u>3</u> <u>Max Speed</u> <u>(mph)</u>
RA-5C	331.0	1,911	1,500
F-14A	327.0	930	1,757
P-3B	213.9	1,123	471
A-6E	142.4	1,119	648
E-1B	104.7	512	243
A-4F	73.3	462	675
C-1A	44.0	449	200
S-2E	31.2	335	265
A-7E	72.1	734	698
E-2C	245.6	1,024	368
RF-8G	207.2	698	1,352
T-28B	55.1	244	350

Sources:

- ¹ Industrial Performance Summary for Naval Air Rework Facilities, FY1976
- ² 3-M Aircraft Maintenance Cost Report, MS04790.A2391-01 for Fy1976
- ³ Jane's All the World's Aircraft, 1974-1975

(U) TABLE A-6

DATA BASE FOR ENGINE REWORK COST-ESTIMATING RELATIONSHIP (U)
(Costs in Thous. of FY76\$)

<u>Engine</u>	<u>1</u> <u>Average Unit</u> <u>Overhaul Cost</u>	<u>2</u> <u>Average Unit</u> <u>Repair Cost</u>	<u>3</u> <u>Turbofan</u> <u>Dummy</u>	<u>4</u> <u>Thrust</u> <u>(Thou.)</u>	<u>5</u> <u>Diameter</u> <u>(Inches)</u>
J52-P8B	37.8	14.9	0	9.3	30.2
J52-P408	44.6	17.6	0	11.2	30.2
J57-P10	48.8	14.6	0	10.5	38.9
J79-GE8	42.6	22.8	0	17	38.3
J79-GE10	42.6	22.4	0	17.9	39.1
TF30-P408	92.3	24.1	1	13.4	42 0
TF30-P412A	118.7	24.5	1	20	50 0
J85-GE4A	25.6	10.3	0	3	17.7
TF41-A2	85.4	25.6	1	15	37.5

Sources:

- 1 Industrial Performance Summary for Naval Air Rework Facilities, FY76
- 2 Ibid.
- 3 Jane's All the World's Aircraft, 1974-75
- 4 Ibid.
- 5 Ibid.

APPENDIX B

COMPUTATION METHODOLOGY FOR TECHNICAL SUPPORT
(Element 18)

COMPUTATION METHODOLOGY FOR TECHNICAL SUPPORT
(Element 18)

The procedure for computing Technical Support can best be explained through the use of three tables. Table B-1 contains the list of input-cost estimates for elements 1-5, 7-9, and 11-13 which are used as proxy variables. Table B-2 contains the three computation procedures, the type aircraft which are appropriate for each procedure, and the various groups of logistics sectors which are used for each type aircraft. Table B-3 contains a listing of all the groups, the logistic sectors contained therein, the proxy variable or variables for that sector or sectors, and the cost factor to be applied to the proxy.

The procedure for generating an estimate would be as follows. First the cost estimates for elements 1-5, 7-9, and 11-13 are obtained and, with the required program data, all the costs shown in Table B-1 are obtained. Secondly, a determination is made as to which type aircraft is being estimated and the appropriate group numbers are noted from Table B-2. Finally, using the groups determined from Table B-2 and the proxy values indicated by Table B-1, the cost factors from Table B-3 are applied and the sector results are summed. The estimate is in thousands of dollars.

Example

As an example, assume the following cost estimates have been prepared for an aircraft being reviewed:

Total Number of Direct Officers	O =	1.69
Total Number of Direct Enlisted	E =	16.63

Annual Replenishment Spares Cost	RS = 64.23
Annual POL Cost	P = 124.85
Annual O&I Material Cost Plus Personnel Support Supplies	OI = 58.04
Annual Engine Overhaul Cost	EO = 41.12
Annual Component Rework Cost	CR = 101.96
Annual A/C Rework Cost	AC = 24.23
Cost per A/C Rework	CA = 96.94
Flying Hours per Year	FY = 420
Aircraft Operations (P+OI)	AO = 182.89
Aircraft Maintenance (EO+CR+AC)	AM = 167.31

The example aircraft is a Type 3 aircraft and therefore is computed by using groups 1,3,4,5,6, and 32 according to Table B-2. Group 1 will be computed in detail.

GROUP 1

<u>Proxy Variables</u>	<u>Factor from Table B-3</u>	<u>Group 1 Technical Support Cost</u>
AO = 182.89		
AM = 167.31		
RS = <u>64.23</u>		
414.43	x 0.0065	= 2.7

Using this procedure all valid groups are computed using the factors in Table B-3 and summed.

<u>Group</u>	<u>Proxy Value</u>	<u>Factor</u>	<u>Estimate</u>
1.	414.43	0.0065	2.7
3.	240.02	0.1951	46.8
4.	18.32	0.0326	0.6
5.	420	0.0179	7.5
6.	240.02	0.0055	1.3
32.	18.32	0.0046	<u>0.1</u>
			59.0

Technical Support 59.0

TABLE B-1
OPERATING AND SUPPORT COST ELEMENTS
WHICH SERVE AS PROXY VARIABLES

<u>Cost</u>	<u>Abbreviation</u>	<u>Source Elements</u>
Total Number of Direct Officers (per A/C)	O	1, 2
Total Number of Direct Enlisted (per A/C)	E	2, 3, 5, 7
Annual Replenishment Spares Cost	RS	22
Annual POL Cost	P	4
Annual O&I Material Cost Plus Personnel Support Supplies Cost	OI	8, 9
Annual Engine Rework Cost	EO	13
Annual Component Rework Cost	CR	11
Annual A/C Rework Cost	AC	12
Cost per A/C Rework	CA	12, Program Data
Flying hours/year	FY	Program Data

For ease of use two more proxy variables will be introduced to represent the frequently used sum of several other variables.

Aircraft Operations

AO = P + OI

Aircraft Maintenance

AM = EO+CR+AC

TABLE B-2
COMPUTATION OF COSTS

<u>Type of Aircraft</u>	<u>Valid Groups</u>
1. Anti-Submarine Warfare Aircraft	1, 2, 3, 4, 5, 6, 32
2. Non-Advanced Developed Aircraft	1, 3, 4, 5, 6, 32, 33, 34, 35
3. All Other Aircraft	1, 3, 4, 5, 6, 32

TABLE B-3
COMPUTATION OF SECTOR COSTS

<u>Group #</u>	<u>Logistic Sector</u>	<u>Title</u>	<u>Proxy Variable</u>	<u>Factor</u>
1	4	NAWESA PROG. MAN. OFF.	AO+AM+RS	0.0065
2	15	SONOBUUY SPT.	AO+AM+RS	0.0289
3	11	NAVAIRSYS COM REPS.	EO+CR+CA	0.1951
	20	TECH. PUB. SPT. , NAESU, A/L WEAPONS R&M, CALIBRATION, GSE REWORK, Et.AL.		
4	89	BASE COMM.	O+E	0.0326
	90	BASE OPS DIRECT		
5	10	FIXED WING EVAL., TACTICS QUAL.EVAL., PHOTOG., SUS. ENGR. A/C, Et.AL.	FY	0.0179
	21	CATS. & ARR. GEAR, OH of A/C CAMERAS, AIRBORNE MINE COUNTERS		
6	26	MAINT. ENGR. SPT.	EO+CR+CA	0.0055
32	92	BASE COMM.	O+E	0.0046
33	3	NAV. PROS.	RS	0.0178
	6	COMMAND		
	13	INSTALL GSE ATE SOFTWARE		
34	12	NAILSC GSE	RS	0.0015
35	87	INIT SPT-PROV. ACT.	RS	0.0023

APPENDIX C
USER INSTRUCTIONS

USER INSTRUCTIONS

1. Introduction

The aircraft model is operated at the Op-96D offices utilizing NCSS VP/CSS, a terminal oriented, dial-up system. It is written in Fortran IV and stored in file¹ AIRMODEL FORTRAN. File definitions and loading statements are stored in file AIRMODEL EXEC. In order to execute the model, one must access the system through an approved user name and password, and type AIRMODEL fn₁ fn₂, where fn₁ and fn₂ are the file names to be used by the model for data input.

fn₁ may be either T (for Terminal) or the name² of a pre-stored file. Initial input entries must be via fn₁.

fn₂ is optional. If no entry is made, all changes and/or thrupt entries are assumed to be via fn₁ otherwise, fn₂ may be either T or the name² of a pre-stored file.

If fn₂ is present, all changes and/or thrupt for the model execution, as well as any subsequent iterations of the model must be made via fn₂.

If either fn₁ or fn₂ is specified as T, the model will instruct the user to enter the appropriate data as needed. Otherwise no comments will be made by the model during the input phase.

¹In the VP/CSS system all files have three identifiers; filename, filetype, and filemode. If omitted, the filemode defaults to P. All files used in connection with this model are filemode P.

²For the input files of this model, two filetype names have been reserved. AIRINP is the filetype associated with fn₁ and AIRTHRU is the filetype associated with fn₂.

2. Input

Whether input directly through the terminal or via a pre-stored file, the input values are entered in the same format, which is as follows:

Name

P_1, P_2, \dots, P_{23}

AC_1, AC_2, \dots, AC_n

Name is a run descriptor (8 character maximum) and P_1 thru P_{23} are parametric values in the order listed in Table C-1. AC_1 is the number of aircraft in year 1, AC_2 is the number of aircraft in year 2, and AC_n is the number of aircraft in year n, where n represents the number of years being computed in this run. The value of n is contained in P_4 . P_1 thru P_{23} may utilize as many lines as required, as may AC_1 thru AC_n ; however, both P_1 and AC_1 must start a line. Since P_5 provides the capability of entering a constant number of aircraft for each year, AC_1 thru AC_n are not always required.

Aircraft input requirements are determined as follows:

if $P_4 = 0$, no life cycle costs are computed;

if $P_4 = n \neq 0$ and $P_5 = 0$, a variable stream of aircraft per year, AC_1, \dots, AC_n , is required;

if $P_4 = n \neq 0$ and $P_5 = m$, no aircraft stream is input, since a constant stream, AC_1, \dots, AC_n , is computed such that all $AC_i = m$.

Changes to Input - Should the user desire to test the results of variations in the basic input, a capability for revising any of the values has been included.

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TABLE C-1
REQUIRED INPUT

INDEX	DESCRIPTION
1	MPN RATE (OFF)
2	MPN RATE (ENL)
3	STARTING FY
4	# OF YEARS
5	# A/C PER YR (EACH)
6	GROUND OFFICERS
7	OFF CREW ALLOW
8	ENL CREW ALLOW
9	MAINT MHR/MO
10	FLYING HRS/MO
11	AIR TAD (000\$)
12	GROSS TAKEOFF WT
13	MAX SPEED (ALT MPH)
14	EMPTY WT (000LBS)
15	THRUST/ENG (000LBS)
16	TIME-B-QVHL (HRS)
17	ENGINE DIAMETER
18	ENG TYP (0JET 1FAN)
19	# OF ENGINES
20	A/C RW CYCLE (MOS)
21	FLYAWAY COST (MIL)
22	TRNG ORDN (THOUS)
23	A/C TYPE (1 2 3)

The change format is as follows:

i, P_i
 : :
 j, P_j
 0, 0
 i, AC_i
 : :
 j, AC_j
 0, 0

where,

i, j = index numbers

P_i, P_j = revised values for the ith and jth parameters

AC_i, AC_j = revised values for the ith and jth years

and 0, 0 terminates each set of changes. Each change pair must be entered on a separate line.

Thruput - In some instances annual costs may be known for a specified element. Therefore, a capability for entering average annual costs directly has been provided. Should any other element cost be dependent on the item selected for thruput, that cost will be computed from the thruput cost. The thruput format is as follows:

i, e_i
 : :
 j, e_j
 0, 0

where,

i, j = element index numbers (see Table C-2)

e_i, e_j = thruput values for the i^{th} and j^{th} average annual cost
and 0,0 terminates the set of thruputs.

3. Model Execution

Input Print Options - Prior to the execution of the model, the user has the option of printing the input to be used, in one of two formats.

a. The program queries the user with DESCRIBE INPUT?, and the user responds with Y or N. If the user answers Y, an input parameter table (Table C-3), and a computed value table (Table C-4), complete with index, value and descriptive text are printed. Next, the string of AC_i values for the required number of years is printed and the model queries the user OK TO GO?. If the user responds Y, the model is executed. If the user responds N and the terminal input mode is in effect, the user will again be instructed to enter changes and thruput as described in preceeding paragraphs. If the terminal input mode is not in effect, the run will terminate and the user must make the required file changes.

b. If the user answered N to DESCRIBE INPUT?, the program query PRINT INPUT? is displayed. If the user responds Y, the input parameter values and the computed values, devoid of descriptive text, and the string of AC values are printed and the program proceeds exactly as described above. The OK TO GO? interrogatory is included to give the user an opportunity to review and confirm input, thruput, and computed values before lengthy output is printed.

TABLE C-2
COST ELEMENTS STRUCTURE WITH INDEX NUMBERS

OPERATING AND SUPPORT COST	
INDEX	ELEMENTS
1	DEPLOYED UNIT OPS
2	AIRCROWS (OFFICERS)
3	AIRCROWS (ENLISTED)
4	COMBAT COMMAND STF
5	POL
6	OTHER DEPLOYED MPN
7	AIR TAD
8	BELOW-DEPOT MAINT
9	A/C MAINT MPN
10	MAINTENANCE MAT'L
11	PERS SUP SUPPLIES
12	INSTALLATIONS SUP
13	BASE OPS SUPPORT
14	O&M BASE OPS
15	MPN BASE OPS
16	DEPOT MAINTENANCE
17	COMPONENT REWORK
18	AIRFRAME REWORK
19	ENGINE REWORK
20	DEPOT SUPPLY
21	DEPOT SUPPLY OPS
22	TECHNICAL SUPPORT
23	2ND DEST TRANS
24	2ND DEST TRANS

TABLE C-2 (cont'd.)

COST ELEMENTS STRUCTURE WITH INDEX NUMBERS

25	PERS SUP & TRAIN
26	INDIVIDUAL TRAIN
27	O&M
28	MPN
29	HEALTH CARE
30	O&M
31	MPN
32	PERS ACTIVITIES
33	O&M
34	MPN
35	SUS INVESTMENTS
36	REPLEN SPARES
37	MODIFICATIONS
38	REPLEN GSE
39	TRAINING ORDNANCE

TABLE C-3

INPUT PARAMETER TABLE

DESCRIBE INPUT ? Y

SAMPLE

INDEX	DESCRIPTION
1	MPN RATE (OFF)
2	MPN RATE (ENL)
3	STARTING FY
4	# OF YEARS
5	# A/C PER YR (EACH)
6	GROUND OFFICERS
7	OFF CREW ALLOW
8	ENL CREW ALLOW
9	MAINT MHR/MO
10	FLYING HRS/MO
11	AIR TAD (000\$)
12	GROSS TAKEOFF WT
13	MAX SPEED (ALT MPH)
14	EMPTY WT (000LBS)
15	THRUST/ENG (000LBS)
16	TIME-B-OVHL (HRS)
17	ENGINE DIAMETER
18	ENG TYP (0JET 1FAN)
19	# OF ENGINES
20	A/C RW CYCLE (MOS)
21	FLYAWAY COST (MIL)
22	TRNG ORDN (THOUS)
23	A/C TYPE (1 2 3)

TABLE C-4
COMPUTED VALUES

COMPUTED

INDEX	DESCRIPTION
1	A/C MAINT MPWR
2	OTHER DEPL MPWR
3	TOTAL DIRECT MPWR
4	DIRECT & B-OP OFF
5	DIRECT & B-OP ENL
6	POL (\$/FH)
7	MM & PSS (\$/FH)
8	COMP REW (000\$/FH)
9	A/C REW (000\$/REW)
10	ENG OVHL (000\$/ENG)
11	ENG REP (000\$/ENG)

Computation - The model then computes average annual cost per UE, for each element, the total program cost for each element for each specified year, and costs by appropriation.

4. Output

Output is printed at the end of each execution of the model. The average annual cost per UE, by element and by appropriation is displayed in the first column. Subsequent columns provide total program costs by year in the same CES. Sample output is provided in Appendix D.

5. Iteration

At the conclusion of each output set, the program queries the user with MORE?. If the user responds with N, the program terminates. If the user responds with Y, the program is ready to accept further variations on input and produce another set of results.

APPENDIX D**SAMPLE RUNS**

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STORED FILE FOR RUN

PRINTF SAMPLE AIRINP

SAMPLE

20.272 3.310 1980 11 0
.25 1.6 1.6 720 30 5 29.7 631 12.3 21.5 1000 40 0 1 30 3.4 40 3
7 19 40 73 105 135 164 192 219 243 268

STORED FILE INPUT

RUN 1

13.22.04 >AIRMODEL SAMPLE T
DISK FILE ASSUMED
EXECUTION:

ENTER PARAMETER CHANGES (INDEX,VALUE)
DELIMITOR = 0,0

>0,0

ENTER AC BY YR CHANGES (YR,VALUE)
WHERE YR=1 THRU 11 AND DELIMITOR = 0,0

>0,0

ENTER THRUPUT VALUES (INDEX,VALUE)
DELIMITOR = 0,0

>0,0

RUN 1 (cont'd.)

DESCRIBE INPUT ?

>Y

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SAMPLE

INDEX	VALUE	DESCRIPTION
1	20.27	MPN RATE (OFF)
2	3.31	MPN RATE (ENL)
3	1930.00	STARTING FY
4	11.00	# OF YEARS
5	0.0	# A/C PER YR
6	0.25	GROUND OFFICERS
7	1.60	OFF CREW ALLOWANCE
8	1.60	ENL CREW ALLOWANCE
9	720.00	MAINT MHR/MO
10	30.00	FLYING HRS/MO
11	5.00	AIR TAD (000\$)
12	29.70	GROSS TAKEOFF WT
13	631.00	MAX SPEED (ALT MPH)
14	12.30	EMPTY WT (000LBS)
15	21.50	THRUST/ENG (000LBS)
16	1000.00	TIME-B-DVHL (HRS)
17	40.00	ENGINE DIAMETER
18	0.0	ENG TYP (0JET 1FAN)
19	1.00	# OF ENGINES
20	30.00	A/C RW CYCLE (MOS)
21	3.40	FLYAWAY COST (MIL)
22	40.00	TRNG DRDN (THOUS)
23	3.00	A/C TYPE (1 2 3)

COMPUTED

INDEX	VALUE	DESCRIPTION
1	14.64	A/C MAINT MPWR
2	2.78	OTHER DEPL MPWR
3	20.37	TOTAL DIRECT MPWR
4	1.39	DIRECT & B-DP OFF
5	19.53	DIRECT & B-DP ENL
6	131.91	POL (\$/FH)
7	134.53	MM & PSS (\$/FH)
8	151.65	COMP REM (000\$/FH)
9	141.45	A/C REM (000\$/REM)
10	49.54	ENG DVHL (000\$/ENG)
11	24.63	ENG REP (000\$/ENG)

A/C PER YR	7.0	19.0	40.0	73.0	105.0	135.0	164.0	192.0	219.0	243.0
	263.0									

TO GO ?

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RUN 1 (cont'd.)

SAMPLE

OPERATING AND SUPPORT COST ESTIMATE (THOUSANDS OF FY76\$)

	AVERAGE ANNUAL COST PER UE	FY80	FY81	FY82	FY83	FY84	FY85
AC PER YR		7.0	19.0	40.0	73.0	105.0	135.0
TOTAL	730	4490	12188	26279	43510	70898	93065
O&M	362	1916	5199	11566	21660	32278	43411
MPN	273	1912	5190	10926	19340	28681	36875
APN	55	333	1038	2186	3990	5733	7373
WPN	40	280	760	1600	2920	4200	5400
DEPLOYED UNIT OPS	147	1026	2786	5865	10703	15395	19793
AIROCREWS (OFFICERS)	32	227	616	1297	2363	3406	4379
AIROCREWS (ENLISTED)	14	99	268	564	1029	1480	1903
COMBAT COMMAND STF	5	35	96	203	370	532	684
POL	65	458	1244	2620	4731	6876	8841
OTHER DEPLOYED MPN	25	172	466	981	1790	2575	3311
AIR TAG	5	35	95	200	365	525	675
BELOW-DEPOT MAINT	177	1242	3370	7095	12948	18624	23946
A&C MAINT MPN	129	903	2450	5158	9413	13539	17403
MAINTENANCE MAT'L	46	319	865	1821	3323	4780	6146
PERS SUP SUPPLIES	3	20	55	116	212	305	392
INSTALLATIONS SUP	16	109	296	622	1136	1633	2100
BASE OPS SUPPORT	16	109	296	622	1136	1633	2100
O&M BASE OPS	10	68	184	387	706	1016	1306
MPN BASE OPS	6	41	112	235	429	617	794
DEPOT MAINTENANCE	143	332	1037	2804	5669	9276	13833
COMPONENT REWORK	55	332	1037	2134	3936	5732	7370
AIRFRAME REWORK	57	0	0	396	1075	2263	4130
ENGINE REWORK	32	0	0	224	603	1281	2337
DEPOT SUPPLY	55	334	1042	2194	4003	5758	7403
DEPOT SUPPLY OPS	12	81	219	461	841	1209	1555
TECHNICAL SUPPORT	43	303	823	1733	3162	4548	5848
2ND DEST TRANS	21	150	407	857	1564	2249	2892
2ND DEST TRANS	21	150	407	857	1564	2249	2892

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RUN 1 (cont'd.)

	AVERAGE ANNUAL COST PER UE	FY80	FY81	FY82	FY83	FY84	FY85
PERS SUP & TRAIN	76	535	1452	3057	5578	8024	10316
INDIVIDUL TRAIN	31	220	597	1256	2293	3298	4240
D&M	5	33	91	191	349	501	645
MPN	27	186	506	1065	1944	2796	3595
HEALTH CARE	16	111	301	634	1156	1663	2138
D&M	7	52	141	297	542	780	1002
MPN	9	59	160	337	614	883	1136
PERS ACTIVITIES	29	204	554	1167	2129	3063	3938
D&M	2	14	38	80	146	211	271
MPN	27	190	516	1086	1983	2852	3667
SUS INVESTMENTS	95	663	1798	3786	6910	9938	12778
REPLEN SPARES	32	225	612	1288	2351	3382	4348
MODIFICATIONS	14	98	265	558	1018	1464	1882
REPLEN GSE	8	59	161	340	620	892	1147
TRAINING ORDNANCE	40	280	760	1600	2920	4200	5400

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RUN 1 (cont'd.)

	FY86	FY87	FY88	FY89	FY90	TOTAL
AC PER YR	164.0	192.0	219.0	243.0	268.0	1465.0
TOTAL	114503	135122	155011	172887	191315	1024268
O&M	54183	64503	74461	83510	92743	435431
MPN	44798	52446	59321	66377	73206	400174
APN	3963	10493	11969	13230	14646	30064
MPN	6560	7680	8760	9720	10720	53600
DEPLOYED UNIT OPS	24045	28150	32109	35627	39293	214790
AIROCREWS (OFFICERS)	5319	6228	7103	7882	8693	47513
AIROCREWS (ENLISTED)	2312	2706	3087	3425	3773	20651
COMBAT COMMAND STF	331	973	1110	1232	1358	7425
POL	10740	12574	14342	15914	17551	95942
OTHER DEPLOYED MPN	4022	4709	5371	5960	6573	35931
AIR TAD	320	960	1095	1215	1340	7325
BELOW-DEPOT MAINT	29090	34056	38345	43102	47537	259854
A/C MAINT MPN	21147	24757	28239	31334	34557	188904
MAINTENANCE MAT'L	7466	3741	9970	11062	12200	66693
PERS SUP SUPPLIES	477	558	636	706	779	4257
INSTALLATIONS SUP	2551	2987	3407	3730	4169	22789
BASE OPS SUPPORT	2551	2987	3407	3730	4169	22789
O&M BASE OPS	1537	1858	2119	2352	2594	14177
MPN BASE OPS	964	1129	1287	1428	1575	8612
DEPOT MAINTENANCE	18256	22443	26487	30278	34035	164503
COMPONENT REWORK	3954	10432	11956	13267	14631	79932
AIRFRAME REWORK	5941	7633	9279	10863	12331	53976
ENGINE REWORK	3362	4323	5251	6143	7012	30547
DEPOT SUPPLY	3993	10529	12009	13326	14697	80337
DEPOT SUPPLY OPS	1889	2212	2523	2799	3037	16375
TECHNICAL SUPPORT	7104	8317	9487	10526	11609	63462
2ND BEST TRANS	3513	4113	4691	5205	5741	31330
2ND BEST TRANS	3513	4113	4691	5205	5741	31330

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RUN 1 (cont'd.)

	FY86	FY87	FY88	FY89	FY90	TOTAL
PERS SUP & TRAIN	12532	14672	16735	18569	20479	111949
INDIVIDUL TRAIN	5151	6030	6878	7632	8417	46011
D&M	783	917	1046	1161	1280	6997
MPN	4367	5113	5832	6471	7137	39014
HEALTH CARE	2598	3041	3469	3849	4245	23206
D&M	1218	1426	1626	1804	1990	10879
MPN	1380	1616	1843	2045	2255	12327
PERS ACTIVITIES	4784	5600	6388	7088	7817	42732
D&M	329	385	439	487	538	2939
MPN	4455	5215	5949	6600	7280	39793
SUS INVESTMENTS	15523	18173	20729	23000	25366	138664
REPLEN SPARES	5283	6185	7054	7827	8633	47189
MODIFICATIONS	2286	2676	3053	3387	3736	20422
REPLEN GSE	1394	1632	1861	2065	2278	12452
TRAINING ORDNANCE	6560	7680	8760	9720	10720	58600

MORE ?

>Y

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TERMINAL CHANGES

RUN 2

Assume that the user wants to investigate the O&S impact of a maintainability improvement. A typical one might be: lower DMMH/MO (#9) to 630, raise GTOW (#12) to 30.4, raise EW (#14) to 12.7, and raise flyaway cost (#21) to 3.9. The changes are input as follows:

ENTER PARAMETER CHANGES (INDEX,VALUE)
DELIMITOR = 0,0

>9,630
>12,30.4
>14,12.7
>21,3.9
>0,0

ENTER AC BY YR CHANGES (YR,VALUE)
WHERE YR=1 THRU 11 AND DELIMITOR = 0,0

>0,0

ENTER THRUPUT VALUES (INDEX,VALUE)
DELIMITOR = 0,0

>0,0

DESCRIBE INPUT ?

>N

PRINT INPUT?

>Y

SAMPLE	20.27	8.81	1980.	11.	0.
0.25	1.60	1.60	630.00	30.00	5.00
30.40	681.00	12.70	21.50	1000.00	40.00
0.0	1.00	30.00	3.90	40.00	3.00
COMPUTED	13.02	2.63	19.10	1.89	17.77
134.19	116.18	129.58	129.71	49.54	24.63

AC PER YR	7.0	19.0	40.0	73.0	105.0	135.0	164.0	192.0	219.0	243.0
	268.0									

OK TO GO ?

>Y

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65

RUN 2 (cont'd.)

SAMPLE

OPERATING AND SUPPORT COST ESTIMATE (THOUSANDS OF FY76\$)

	AVERAGE ANNUAL COST PER UE	FY80	FY81	FY82	FY83	FY84	FY85
AD PER YR		7.0	19.0	40.0	73.0	105.0	135.0
TOTAL	681	4182	11350	24482	45203	66081	86771
DDM	336	1764	4788	10667	19989	29315	40144
MPN	252	1765	4790	10095	18405	26473	34037
APN	53	373	1012	2131	3888	5593	7190
MPN	40	280	760	1600	2920	4200	5400
DEPLOYED UNIT OPS	146	1023	2776	5844	10666	15341	19724
AIROCREWS (OFFICERS)	32	227	616	1297	2368	3406	4379
AIROCREWS (ENLISTED)	14	99	268	564	1029	1430	1903
COMBAT COMMAND STF	5	35	96	203	370	532	684
POL	66	464	1760	2652	4841	6962	8952
OTHER DEPLOYED MPN	23	162	441	928	1693	2436	3132
AIR TAD	5	35	95	200	365	525	675
BELOW-DEPOT MAINT	156	1095	2973	6260	11424	16431	21126
A/C MAINT MPN	115	803	2179	4587	8371	12040	15430
MAINTENANCE MAT'L	39	275	747	1573	2870	4123	5303
PERS SUP SUPPLIES	3	18	48	100	183	263	339
INSTALLATIONS SUP	14	100	270	569	1039	1495	1922
BASE OPS SUPPORT	14	100	270	569	1039	1495	1922
DDM BASE OPS	9	62	168	354	646	930	1196
MPN BASE OPS	5	38	102	215	393	565	726
DEPOT MAINTENANCE	131	327	386	2453	5000	3254	12123
COMPONENT REWORK	47	327	386	1866	3405	4333	6233
AIRFRAME REWORK	52	0	0	363	996	2075	3733
ENGINE REWORK	32	0	0	224	608	1281	2337
DEPOT SUPPLY	51	355	963	2027	3699	5321	6841
DEPOT SUPPLY OPS	11	75	203	427	780	1121	1442
TECHNICAL SUPPORT	40	280	760	1600	2919	4199	5399
END DEST TRANS	20	138	374	788	1438	2063	2653
END DEST TRANS	20	138	374	788	1438	2063	2653

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RUN 2 (cont'd.)

	AVERAGE ANNUAL COST PER UE	FY80	FY81	FY82	FY83	FY84	FY85
PERS SUP & TRAIN	70	492	1335	2811	5129	7378	9486
INDIVIDUL TRAIN	29	202	547	1152	2103	3025	3890
O&M	4	31	83	175	319	459	590
MPN	24	171	464	978	1784	2566	3300
HEALTH CARE	14	101	275	580	1058	1522	1956
O&M	7	48	129	272	496	714	917
MPN	8	54	146	308	562	808	1039
PERS ACTIVITIES	27	189	512	1079	1968	2831	3640
O&M	2	13	35	73	133	191	246
MPN	25	176	478	1006	1835	2640	3394
SUS INVESTMENTS	93	653	1772	3731	6808	9793	12590
REPLEN SPARES	28	193	523	1101	2009	2890	3716
MODIFICATIONS	16	112	304	640	1167	1679	2159
REPLEN GSE	10	68	185	390	712	1024	1316
TRAINING ORDNANCE	40	280	760	1600	2920	4200	5400

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RUN 2 (cont'd.)

	FY86	FY87	FY88	FY89	FY90	TOTAL
AC PER YR	164.0	192.0	219.0	243.0	268.0	1465.0
TOTAL	106780	126023	144536	161272	178472	955201
O&M	50136	59709	68946	77343	85908	449209
MPN	41348	48408	55215	61266	67569	369362
APN	8735	10226	11665	12943	14274	78030
MPN	6560	7680	8760	9720	10720	58600
DEPLOYED UNIT OPS	23962	23053	31997	35504	39157	214046
AIRCROWS (OFFICERS)	5319	6228	7103	7882	8693	47513
AIRCROWS (ENLISTED)	2312	2706	3087	3425	3778	20651
COMBAT COMMAND STF	331	973	1110	1232	1358	7425
POL	10875	12731	14522	16113	17771	97143
OTHER DEPLOYED MPN	3305	4454	5080	5637	6217	33935
AIR TAD	320	960	1095	1215	1340	7325
BELOW-DEPOT MAINT	25664	30046	34271	38027	41939	229258
A/C MAINT MPN	18805	22016	25112	27864	30730	167985
MAINTENANCE MAT'L	6448	7549	8610	9554	10536	57597
PERS SUP SUPPLIES	412	482	550	610	673	3676
INSTALLATIONS SUP	2335	2733	3118	3459	3815	20355
BASE OPS SUPPORT	2335	2733	3118	3459	3815	20355
O&M BASE OPS	1452	1700	1939	2152	2373	12974
MPN BASE OPS	882	1033	1178	1307	1442	7881
DEPOT MAINTENANCE	16460	20284	23976	27445	30877	148384
COMPONENT REMORK	7650	9957	10216	11336	12502	68340
AIRFRAME REMORK	5443	7004	8509	9932	11333	49493
ENGINE REMORK	3362	4323	5251	6148	7012	30547
DEPOT SUPPLY	8310	9729	11097	12313	13580	74236
DEPOT SUPPLY OPS	1751	2051	2339	2595	2862	15646
TECHNICAL SUPPORT	6559	7679	8758	9718	10718	58590
END TEST TRANS	3230	3731	4313	4786	5278	28851
END TEST TRANS	3230	3731	4313	4786	5278	28851

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RUN 2 (cont'd.)

	FY86	FY87	FY88	FY89	FY90	TOTAL
PERS SUP & TRAIN	11524	13491	15388	17075	18831	102941
INDIVIDUL TRAIN	4725	5532	6310	7001	7722	42210
DSM	717	839	957	1062	1171	6401
MPN	4009	4693	5353	5940	6551	35803
HEALTH CARE	2377	2782	3174	3521	3884	21229
DSM	1114	1305	1439	1651	1821	9955
MPN	1262	1478	1685	1870	2062	11274
PERS ACTIVITIES	4422	5177	5905	6552	7226	39502
DSM	298	349	399	442	488	2666
MPN	4124	4828	5506	6110	6739	36836
SUS INVESTMENTS	15295	17906	20425	22663	24994	136630
REPLEN SPARES	4514	5284	6027	6688	7376	40321
MODIFICATIONS	2622	3070	3502	3886	4285	23425
REPLEN GSE	1599	1872	2135	2369	2613	14284
TRAINING ORDNANCE	6560	7680	8760	9720	10720	53600

MORE ?

>N

13.36.18 >LOGOUT

APPENDIX E
PROGRAM CODE

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70

PRINTF AIRMODEL EXEC

%TYPE OFF

%F1 = 3

%IF %1 NE T %SKIP 2

%F1 = 5

%SKIP 1

FILEDEF FT03F001 %1 AIRINP

%IF %INDEX EQ 2 %SKIP 2

%F2 = %F1

%GOTO -REST

%F2 = 4

%IF %2 NE T %SKIP 2

%F2 = 5

%SKIP 1

FILEDEF FT04F001 %2 AIRTHRU

-REST

FILEDEF FT05F001 CONI

FILEDEF FT05F002 CONI

FILEDEF FT05F003 CONI

FILEDEF FT05F004 CONI

FILEDEF FT05F005 CONI

FILEDEF FT05F006 CONI

FILEDEF FT05F007 CONI

FILEDEF FT05F008 CONI

FILEDEF FT05F009 CONI

FILEDEF FT05F010 CONI

FILEDEF FT05F011 CONI

FILEDEF FT05F012 CONI

FILEDEF FT03F001 CONI

%STACK %F1 %F2

LOAD AIRMODEL

START

```

C:      AIRMODL FORTRAN
COMMON /DAT/ SDAT(20,40), STDT(20,5), ACY(20)
COMMON /PAR/ APIN(30), APCM(20), JP, JT, KT, IN1, IN2
COMMON /UTL/ ISC(40), ISQ(40), ISV(40), ISX(40)
COMMON /WRD/ SNAM, SWD(5,39), PWD(5,34)

C:      REAL*8 SNAM, COMP
      DIMENSION PIN(23), PCM(11)
      EQUIVALENCE (PIN,APIN), (PCM,APCM)
      DATA COMP//COMPUTED//, NYES//Y//, NOND//N//

C:
5  FORMAT(A1)
9  FORMAT(10X, '++ ? ? ? ++')
20 FORMAT(//4X, 'DESCRIBE INPUT ? ')
22 FORMAT(//5X, A8//5X, 'INDEX', 7X, 'VALUE', 6X, 'DESCRIPTION')
1  (8X, I2, F12.2, 6X, 4A4, A2) )
30 FORMAT(4X, 'PRINT INPUT? ')
32 FORMAT(//6X, A8, 5X, 2F10.2, F8.0, 2F10.0/ (9X, 6F10.2) )
34 FORMAT(//8X, A8, 3X, 5F10.2/ (9X, 6F10.2) )
38 FORMAT(//6X, 'AC PER YR', 1X, 10F6.1/16X, 10F6.1)
40 FORMAT(//4X, 'OK TO GO ? ')
60 FORMAT(//4X, 'MORE ? ')

C:
      CALL PIKFIL (IN1, IN2)
      IF (IN1.EQ.0) RETURN
      CALL RDINP (IERR)
      IF (IERR.EQ.1) RETURN
100 CALL RDTHRU (IERR)

C:
      IF (KY.EQ.1.OR.PIN(5).EQ.0) GO TO 200
      DO 152 I=2, KT
152  ACY(I) = PIN(5)

C:
200 CALL DDEO
      JC = 11
220 WRITE (8,20)
      READ (5,5) NYN
      IF (NYN.EQ.NOND) GO TO 230
      IF (NYN.EQ.NYES) GO TO 224
      WRITE (8,9)
      GO TO 220
224 WRITE (8,22) SNAM, (J, PIN(J), (PWD(I,J), I=1,5), J=1, JP)
      WRITE (8,23) COMP, (J, PCM(J), (PWD(I,J+JP), I=1,5), J=1, J)
      GO TO 233

C:
230 WRITE (8,30)
      READ (5,5) NYN
      IF (NYN.EQ.NOND) GO TO 240
      IF (NYN.EQ.NYES) GO TO 234
      WRITE (8,9)

```

```
      GO TO 230
234 WRITE (8,32)  SNAM, PIN
      WRITE (8,34)  COMP, PCM
238 WRITE (8,38)  (ACY(I), I=2,KT)
240 WRITE (8,40)
      READ (5,5)  NYN
      IF (NYN.EQ.NYES) GO TO 250
      IF (IN2.EQ.5) GO TO 100
      GO TO 400
C:
250 DO 298 JJ=1,JT
      J = ISC(JJ)
      DO 298 I=1,KT
      ANS = SDAT(I,J)
      IF (ISV(J).EQ.0.OR.I.GT.1) CALL ESTM (I,J,ANS)
      SDAT(I,J) = ANS
      IF (ISC(J).EQ.0) GO TO 270
      SDAT(I,ISC(J)) = SDAT(I,ISC(J)) + ANS
      IF (ISX(J).GT.1) STOT(I,ISX(J)) = STOT(I,ISX(J)) + ANS
      GO TO 298
270 STOT(I,1) = STOT(I,1) + ANS
298 CONTINUE
C:
      DO 318 I=2,KT
      ACY(KT+1) = ACY(KT+1) + ACY(I)
      DO 308 J=1,5
308 STOT(KT+1,J) = STOT(KT+1,J) + STOT(I,J)
      DO 318 J=1,JT
318 SDAT(KT+1,J) = SDAT(KT+1,J) + SDAT(I,J)
C:
      CALL ACPRN
      IF (IERR.EQ.9) GO TO 400
320 WRITE (8,60)
      READ (5,5)  NYN
      IF (NYN.EQ.NOND) GO TO 400
      IF (NYN.EQ.NYES) GO TO 324
      WRITE (8,9)
      GO TO 320
324 KTT = KT+1
      DO 338 I=1,KTT
      DO 328 J=1,5
328 STOT(I,J) = 0
      DO 338 J=1,JT
      IF (ISV(J).EQ.0) SDAT(I,J) = 0
      IF (I.EQ.KT+1) SDAT(I,J) = 0
338 CONTINUE
      ACY(KT+1) = 0
      GO TO 100
400 RETURN
      END
```


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```

SUBROUTINE PIKFIL (IN1,IN2)
REAL*8 KN1,KN2
INTEGER*2 LN1(4), LN2(4), NN(3)
EQUIVALENCE (KN1, LN1), (KN2, LN2)
DATA NN/'3', '4', '5'/
1 FORMAT(2A3)
30 FORMAT('/10X, 'FILE ID ERROR - RUN ABORTS', 20X, 2I2'/)
32 FORMAT('/10X, 'EOF ON 5'/)

C:
READ (5,1,END=112) KN1, KN2
C:
WRITE (8,1) KN1,KN2
IN1 = 0
IN2 = 0
DO 102 N=1,3
IF (LN1(1).EQ.NN(N)) IN1 = N+2
IF (LN2(1).EQ.NN(N)) IN2 = N+2
102 CONTINUE
IF (IN1.EQ.3.OR.IN1.EQ.5) GO TO 120
110 WRITE (8,30) IN1,IN2
IN1 = 0
RETURN
112 WRITE (8,32)
RETURN
120 IF (IN2.LT.3.OR.IN2.GT.5) GO TO 110
RETURN
END
SUBROUTINE RDINP (IERR)
COMMON /DAT/ SDAT(20,40), STAT(20,5), ACY(20)
COMMON /PAR/ APIN(30), APCM(20), JP,JT,KT, IN1, IN2
COMMON /UTL/ ISC(40), ISQ(40), ISV(40), ISX(40)
COMMON /WRD/ SNAM, SWD(5,39)

C:
REAL*8 SNAM
DIMENSION PIN(23), PCM(11)
EQUIVALENCE (PIN,APIN), (PCM,APCM)

C:
1 FORMAT(///)
2 FORMAT(A3)
40 FORMAT('/10X, 'ENTER ID (3 CHAR MAX)'/)
42 FORMAT('/10X, 'ENTER', I2, 'PARAMETER VALUES'/)
44 FORMAT('/10X, 'ENTER AC VALUES FOR EACH YR (', I2, ' VALUES)'/)

C:
IF (IN1.EQ.5) GO TO 200
READ (IN1,2,END=113) SNAM
READ (IN1,*,END=113) PIN
KT = PIN(4)+1
IF (KT.EQ.1.OR.PIN(5).GT.0) GO TO 110
READ (IN1,*,END=113) (ACY(I), I=2,KT)
110 RETURN
113 WRITE (8,32)

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```

32 FORMAT(//10X,'INSUFFICIENT DATA IN INPUT FILE - RUN ABORTS'//)
      IERR = 1
      RETURN
C:
200 WRITE (8,1)
      WRITE (8,40)
      READ (5,2)   SNAM
      WRITE (8,42)  JP
      READ (5,4)   PIN
      KT = PIN(4)+1
      IF (KT.EQ.1.OR.PIN(5).GT.0)   GO TO 290
      KTT = KT-1
      WRITE (8,44)  KTT
      READ (5,4)   (ACY(I), I=2,KT)
290 RETURN
      END
      SUBROUTINE RDTHRU (IERR)
      COMMON /DAT/ SDAT(20,40), STDT(20,5), ACY(20)
      COMMON /PAR/ APIN(30), APCM(20),   JP, JT, KT,   IN1, IN2
      COMMON /UTL/ ISC(40), ISQ(40), ISV(40), ISX(40)
      COMMON /WRD/ SNAM, SWD(5,39)
C:
      REAL*8  SNAM
      DIMENSION  PIN(23), PCM(11)
      EQUIVALENCE  (PIN,APIN), (PCM,APCM)
C:
      1 FORMAT(//)
      50 FORMAT(//10X,'ENTER PARAMETER CHANGES (INDEX,VALUE)'//
      1          35X,'DELIMITOR = 0,0' )
      52 FORMAT(//10X,'ENTER AC BY YR CHANGES (YR,VALUE)'//
      1          12X,'WHERE YR=1 THRU 12, AND DELIMITOR = 0,0' )
      54 FORMAT(//10X,'ENTER THRU PUT VALUES (INDEX,VALUE)'//
      1          35X,'DELIMITOR = 0,0' )
      56 FORMAT(4X,'++ ? ? ? ++')
C:
      IF (IN2.EQ.5)   GO TO 200
C:  CHECK CHANGES
      DO 112 J=1,JP
      READ (IN3,*,END=114)  JX, TMP
      IF (JX.EQ.0) GO TO 120
      112  PIN(JX) = TMP
      114  KT = PIN(4)+1
      GO TO 140
C:  CHECK AC CHANGES
      120  KT = PIN(4)+1
      IF (KT.EQ.1.OR.PIN(5).GT.0)   GO TO 130
      DO 122 I=2,KT
      READ (IN2,*,END=140)  IX, TMP
      IF (IX.EQ.0)   GO TO 130
      122  ACY(IX+1) = TMP

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C: CHECK THRUPUT
  130 DO 132 J=1,JT
    READ (IN2,*,END=140) JK, TMP
    IF (JK.EQ.0) GO TO 138
    SDAT(1,JK) = TMP
  132 ISV(JK) = 1
  138 RETURN
  140 IERR = 9
    RETURN

C:
  200 WRITE (8,1)
  202 WRITE (8,50)
  204 CONTINUE
    READ (5,*,END=220) JK, TMP
    IF (JK.GE.0.AND.JK.LE.JP) GO TO 210
  208 WRITE (8,58)
    GO TO 202
  210 IF (JK.EQ.0) GO TO 220
    PIN(JK) = TMP
    GO TO 204

C: AC CHANGES
  220 KT = PIN(4)+1
    KTT = PIN(4)
    IF (KT.EQ.1.OR.PIN(5).GT.0) GO TO 240
  222 WRITE (8,52) KTT
  224 CONTINUE
    READ (5,*,END=240) IX, TMP
    IF (IX.GE.0.AND.IX.LT.KT) GO TO 230
  228 WRITE (8,58)
    GO TO 222
  230 IF (IX.EQ.0) GO TO 240
    ACY(IX+1) = TMP
    GO TO 224

C: THRUPUT
  240 WRITE (8,54)
  244 CONTINUE
    READ (5,*,END=260) JK, TMP
    IF (JK.GE.0.AND.JK.LE.JT) GO TO 250
  248 WRITE (8,58)
    GO TO 244
  250 IF (JK.EQ.0) GO TO 260
    SDAT(1,JK) = TMP
    ISV(JK) = 1
    GO TO 244
  260 RETURN
    END
    SUBROUTINE D050
    COMMON /PAR/ FP,EP,FY,YRS,AC, DDP,DCA,ECA,PMQ,FM, AT,GT,SA,EW,TE
    1 ,TB,DE,TD,EN,P, FC,TD,TYP, XTI(7)
    2 ,PMT,DEP,PAL,POF,PEN,POL, DDC,CR,AR,ERD,ERM, XTC(9)

```


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DATA NA/12/

C:

```

PMT = 1.66975 + .018009*PMD
DEP = (-6.03260 + 2.6771*SQRT((DDP+DCA+PMT+ECA)*NA))/NA
PAL = DDP + DCA + DEP + ECA + PMT
PDF = DDP + DCA + .0021348*PAL
PEN = DEP + ECA + PMT + .027053*PAL
POL = EXP(-1.87782 + .53428*ALOG(ST) + .80777*ALOG(SA))
DDC = EXP(-4.72801 + .36863*ALOG(SA) + 1.0931*ALOG(PMD))
CR = EXP(-.31909 + 1.2486*ALOG(PMD/FM) + .40475*ALOG(ST))
AR = -15.07819 + .13041*PMD + .091969*SA
ERO = 1.09326 + 45.664*TD + 1.2111*DE
ERM = 8.46857 + 4.1332*TD + .75165*TE

```

RETURN

END

SUBROUTINE ESTM (I,J,ANS)

COMMON /DAT/ SDAT(20,40), STOT(20,5), ACY(20)

COMMON /PAR/ FP,EP,FY,YRS,AC,DDP,DCA,ECA,PMD,FM,AT,GT,SA,EW,TE

1 ,TB,DE,TD,EN,P,FC,TD,TYP, KTI(?)

2 ,PMT,DEP,PAL,PDF,PEN,POL,DDC,CR,AR,ERO,ERM, KTC(9)

C:

KTR = ANS

ANS = 0.0

LAG = 0

IF (I.EQ.1) GO TO 90

GO TO (9,80,80,80,80,80,80,9,30,80,80,9,9,80,80,9,80,53,59

1 ,9,80,80,9,80,9,9,80,80,9,80,80,9,80,80,30,30), J

53 LAG = P/12

GO TO 30

59 LAG = INT (TB/(12*FM))

30 IF (LAG.GE.1) GO TO 9900

ANS = SDAT(1,J)*ACY(I-LAG)

GO TO 9900

C:

90 GO TO (9,200,300,400,500,600,700,9,900,1000,1100,9,9,1400,1500,9

1 ,1700,1800,1900,9,2100,2200,9,2400,9,9,2700,2800,9,3000

2 ,3100,9,3300,3400,9,3500,3700,3800,3900), J

9 ANS = KTR

GO TO 9900

C:

300 ANS = FP*DCA

GO TO 9900

300 ANS = EP*ECA

GO TO 9900

400 ANS = FP*DDP

GO TO 9900

500 ANS = POL

GO TO 9900

600 ANS = EP*DEP

GO TO 9900

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```

700   ANS = AT
      GO TO 9900
C:
900   ANS = EP+PMT
      GO TO 9900
1000  ANS = 0.940+DDC
      GO TO 9900
1100  ANS = 0.060+DDC
      GO TO 9900
C:
1400  ANS = .4637+PAL
      GO TO 9900
1500  ANS = (.0021348+FP + .027058+EP)+PAL
      GO TO 9900
C:
1700  ANS = CR
      GO TO 9900
1800  ANS = AR+12/P
      GO TO 9900
1900  ANS = EN+(ERO + 1.6+ERM)+1000./TB
      GO TO 9900
C:
2100  ANS = .024656+(SDAT(1,5)+SDAT(1,10)+SDAT(1,11)+SDAT(1,16)+AT)
      ANS = ANS + .024656*(FP+(DDP+DCA)+EP+(DEP+ECA+PMT))
      GO TO 9900
2200  SUM = .006528 + .02890+MAX1(2.0-TYP,0.0)
      ANS = SUM+(SDAT(1,5)+SDAT(1,10)+SDAT(1,11)+SDAT(1,16)
1      +SDAT(1,36))
      SUM = .19507 + .005512
      ANS = ANS + SUM*(SDAT(1,17)+SDAT(1,19)+AR)
      ANS = ANS + (.032606+.004531)+PAL + .017852+12+FM
      ANS = ANS + .021512*(1.0-ABS(2.0-TYP))+SDAT(1,36)
      ANS = ANS - SDAT(1,21)
      GO TO 9900
C:
2400  ANS = .057243+(SDAT(1,5)+SDAT(1,10)+SDAT(1,11)+SDAT(1,17)
1      +SDAT(1,19)+AR+SDAT(1,36))
      GO TO 9900
C:
2700  ANS = .215323*(PDF+PEN) + .007169+PEN
      GO TO 9900
2800  ANS = FP*(.003891*(PDF+PEN) + .000186+PEN + .066930+PDF)
      ANS = ANS + EP*(.025270*(PDF+PEN) + .101485+PEN)
      GO TO 9900
C:
3000  ANS = .345716*(PDF+PEN)
      GO TO 9900
3100  ANS = FP*(.009431*(PDF+PEN) + .0009335+PDF)
      ANS = ANS + EP*(.0190166*(PDF+PEN) + .005021+PEN)
      GO TO 9900

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C:
3300   ANS = .102434*PEN
      GO TO 9900
3400   ANS = FP*(.000948*PEN + .057745*PDF)
      ANS = ANS + EP*(.007972+.050742+.00288)*PEN
      ANS = ANS + 1.760356*PDF + .541521*PEN
      GO TO 9900

C:
3600   ANS = 0.59*SDAT(1,17)
      GO TO 9900
3700   ANS = 4.1 * FC
      GO TO 9900
3800   ANS = 2.5 * FC
      GO TO 9900
3900   ANS = TO
      GO TO 9900

C:
9300   ANS = ANS * 12*FM/1000.
9900   RETURN
      END
      SUBROUTINE ACPRN
      COMMON /DAT/ SDAT(20,40), STOT(20,5), ACY(20)
      COMMON /PAR/ APIN(30), APCM(20), JP,JT,KT, IN1, IN2
      COMMON /UTL/ ISC(40), ISQ(40), ISV(40), ISX(40)
      COMMON /WRD/ SNAM, SMD(5,39)

C:
      REAL*8 SNAM, WTOT(5), FY(20), SY(30)
      DIMENSION PIN(23), PCM(11), IDAT(20)
      EQUIVALENCE (PIN,APIN), (PCM,APCM)

C:
      DATA WTOT//TOTAL//, D3M//, MPN//, APN//, WPN//
      DATA SY// FY71//, FY72//, FY73//, FY74//, FY75//, FY76//, FY77//
1      , FY78//, FY79//, FY80//, FY81//, FY82//, FY83//, FY84//
2      , FY85//, FY86//, FY87//, FY88//, FY89//, FY90//, FY91//
3      , FY92//, FY93//, FY94//, FY95//, FY96//, FY97//, FY98//
4      , FY99//, TOTAL//

C:
1  FORMAT(//)
2  FORMAT(////)
3  FORMAT(1H )
10 FORMAT(//35X,A3//20X,'OPERATING AND SUPPORT COST ESTIMATE'//
1      27X,'(THOUSANDS OF FY76$)')
12 FORMAT(20X,'AVERAGE ANNUAL'//29X,'COST'//28X,'PER UE',6(2X,A5))
13 FORMAT(27X,7(2X,A5))
13 FORMAT(/12X,'AC PER YR',13X,6F7.1)
19 FORMAT(/12X,'AC PER YR',6X,7F7.1)
20 FORMAT(12X,A5,10X,7I7)
32 FORMAT(/4X,4A4,A2,5X,7I7)
34 FORMAT(6X,4A4,A2,3X,7I7)
36 FORMAT(8X,4A4,A2,1X,7I7)

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```

C:      IFY = PIN(3)-1972
      DO 128 I=2,KT
128      FY(I) = SY(I+IFY)
          FY(KT+1) = WTOT(1)
      WRITE (8,1)
      WRITE (8,10)  SNAM
          IT = 0
150      IB = IT+1
          IT = MIN0(IB+6,KT+1)
          IIT = MIN0(IT,KT)
          JB = 1
          JTT = 24
160      IF (IB.EQ.1) WRITE (8,12)  (FY(I), I=2,IT)
          IF (IB.GT.1) WRITE (8,13)  (FY(I), I=IB,IT)
          IF (JB.GT.1) GO TO 250
          IF (IB.EQ.1) WRITE (8,18)  (ACY(I), I=2,IT)
          IF (IB.GT.1) WRITE (8,19)  (ACY(I), I=IB,IT)
      WRITE (8,3)
      DO 218 J=1,5
      DO 212 I=IB,IT
212      IDAT(I) = SDAT(I,J)+0.5
218      WRITE (8,20)  WTOT(J), (IDAT(I), I=IB,IT)
C:
250      DO 278 J=JB,JTT
          NS = J
          DO 252 N=1,3
          IF (ISC(NS).EQ.0) GO TO 260
252      NS = ISC(NS)
          N = 3
260      DO 262 I=IB,IT
262      IDAT(I) = SDAT(I,J)+0.5
          GO TO (272,274,276), N
272      WRITE (8,32)  (SMD(I,J), I=1,5), (IDAT(I), I=IB,IT)
          WRITE (8,3)
          GO TO 278
274      WRITE (8,34)  (SMD(I,J), I=1,5), (IDAT(I), I=IB,IT)
          GO TO 278
276      WRITE (8,36)  (SMD(I,J), I=1,5), (IDAT(I), I=IB,IT)
278      CONTINUE
          WRITE (8,2)
          IF (JTT.EQ.JT) GO TO 300
          JB = JTT+1
          JTT = JT
          GO TO 160
300      IF (IT.LT.KT) GO TO 150
      RETURN
      END

```

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BLOCK DATA

COMMON /DAT/ SDAT(20,40), STOT(20,5), ACY(20)

COMMON /PAR/ APIN(30), APCM(20), JP, JT, KT, IN1, IN2

COMMON /UTL/ ISC(40), ISQ(40), ISV(40), ISX(40)

COMMON /WRD/ SNAM, SD1(5,19), SD2(5,5), SD3(5,15)

* ,PD1(5,19), PD2(5,15)

C:

REAL*8 SNAM

C:

DATA SDAT/800+0.0/, STOT/100+0.0/, ACY/20+0.0/

1 ,APIN/30+0.0/, APCM/20+0.0/

DATA JP/23/, JT/39/, KT/0/, IN1/0/, IN2/0/

DATA ISC/0,6+1, 0,3+8, 0,12+2+13, 0,3+16, 0,2+20, 0,23

* ,0,25,2+26,25,2+29,25,2+32, 0,4+35/

DATA ISQ/19,18,17,16,15,14,13,12,11,10,9,8,7,6,5,4,3,2,1, 39,39

1 ,37,36,35,34,33,32,31,30,29,28,27,26,25,24,23,21,22,20/

DATA ISX/1,3+3,2,3,2, 1,3,2,2, 1,1,2,3, 1,3+2, 1,2+2, 1,2

1 ,1,1,2,3,1,2,3,1,2,3, 1,3+4,5/, ISV/40+0/

C:

DATA PD1//MPN//,RATE//,COF//,F//,//

2 ,MPN//,RATE//,CEN//,L//,//

3 ,STAR//,TING//,FY//,//,//

4 ,% OF//,YEA//,RS//,//,//

5 ,% A//,C PE//,R YR//,//,//

6 ,GROU//,ND O//,FFIC//,ERS//,//

7 ,OFF//,CREW//,ALL//,OWAN//,CE//

8 ,ENL//,CREW//,ALL//,OWAN//,CE//

9 ,MAIN//,T MH//,R/MO//,//,//

* ,FLYI//,NG H//,RS/M//,O//,//

1 ,AIR//,TAD//,(000//,\$)//,//

2 ,GROS//,S TA//,KEOF//,F WT//,//

3 ,MAN//,SPEE//,D(CAL//,T MP//,H)//

4 ,EMPT//,Y WT//,(00//,0LBS//,)//

5 ,THRU//,ST/E//,NG(O//,00LB//,S)//

6 ,TIME//,-B-O//,VHL//,(HRS//,)//

7 ,ENGI//,NE D//,IAME//,TER//,//

8 ,ENG//,TYP//,OJET//,1FA//,N//

9 ,% OF//,ENG//,INES//,//,//

DATA PD2//A/C//,RM O//,VOLE//,(MO//,S)//

1 ,FLYA//,WAY//,COST//,(MI//,L)//

2 ,TRNG//,ORD//,N(T//,HOUS//,)//

3 ,A/C//,TYPE//,(1//,2 3)//,//

1 ,A/C//,MAIN//,T MP//,WR//,//

2 ,OTHE//,R DE//,PL M//,PWR//,//

3 ,TOTA//,L DI//,RECT//,MPW//,R//

4 ,DIRE//,CT &//,B-O//,P OF//,F//

5 ,DIRE//,CT &//,B-O//,P EN//,L//

6 ,POL//,(\$/F//,H)//,//,//

7 ,MM &//,PSS//,(\$//,FH)//,//

8 ,COMP//,REW//,(00//,0\$/F//,H)//

9 , 'A/C', 'REW', '000', '\$/RE', 'W'
 * , 'ENG', 'QVHL', '000', '\$/EN', 'G'
 1 , 'ENG', 'REP', '000', '\$/EN', 'G'

C:

DATA SD1//DEPL, 'DYED', 'UNI', 'T OP', 'S'
 2 , 'AIRC', 'REWS', 'COFF', 'ICER', 'S'
 3 , 'AIRC', 'REWS', 'ENL', 'ISTE', 'D'
 4 , 'COMB', 'AT C', 'OMMA', 'ND S', 'TF'
 5 , 'POL', ' ', ' ', ' ', ' '
 6 , 'OTHE', 'R DE', 'PLOY', 'ED M', 'PN'
 7 , 'AIR', 'TAD', ' ', ' ', ' '
 8 , 'BELO', 'W-DE', 'POT', 'MAIN', 'T'
 9 , 'A/C', 'MAIN', 'T MP', 'N', ' '
 * , 'MAIN', 'TENA', 'NCE', '4HMT', 'L'
 1 , 'PERS', 'SUP', 'SUP', 'PLIE', 'S'
 2 , 'INST', 'ALLA', 'TION', 'S SU', 'P'
 3 , 'BASE', 'OPS', 'SUP', 'PORT', ' '
 4 , 'D&M', 'BASE', 'OPS', ' ', ' '
 5 , 'MPN', 'BASE', 'OPS', ' ', ' '
 6 , 'DEPO', 'T MA', 'INTE', 'NANC', 'E'
 7 , 'COMP', 'ONEN', 'T RE', 'WORK', ' '
 8 , 'AIRF', 'RAME', 'REW', 'ORK', ' '
 9 , 'ENGI', 'NE R', 'EWOR', 'K', ' '

C:

DATA SD2//DEPO, 'T SU', 'PPLY', ' ', ' '
 1 , 'DEPO', 'T SU', 'PPLY', 'OPS', ' '
 2 , 'TECH', 'NICA', 'L SU', 'PPOR', 'T'
 3 , 'END', 'DEST', 'TRA', 'NS', ' '
 4 , 'END', 'DEST', 'TRA', 'NS', ' '

C:

DATA SD3//PERS, 'SUP', ' & T', 'RAIN', ' '
 5 , 'INDI', 'VIDU', 'L TR', 'AIN', ' '
 6 , 'D&M', ' ', ' ', ' ', ' '
 7 , 'MPN', ' ', ' ', ' ', ' '
 8 , 'HEAL', 'TH C', 'ARE', ' ', ' '
 9 , 'D&M', ' ', ' ', ' ', ' '
 * , 'MPN', ' ', ' ', ' ', ' '
 1 , 'PERS', 'ACT', 'IVIT', 'IES', ' '
 2 , 'D&M', ' ', ' ', ' ', ' '
 3 , 'MPN', ' ', ' ', ' ', ' '
 4 , 'SUS', 'INVE', 'STME', 'NTS', ' '
 5 , 'REPL', 'EN S', 'PARE', 'S', ' '
 6 , 'MODI', 'FICA', 'TION', 'S', ' '
 7 , 'REPL', 'EN G', 'SE', ' ', ' '
 8 , 'TRAI', 'NING', 'ORD', 'NANC', 'E'

END

EOF: